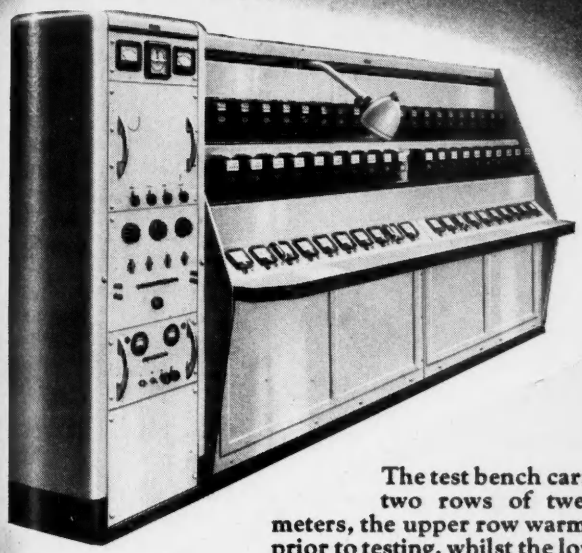
ELECTRICAL REVIEW

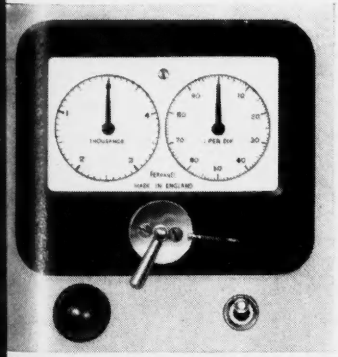


The test bench carries two rows of twenty meters, the upper row warming prior to testing, whilst the lower row is being calibrated.

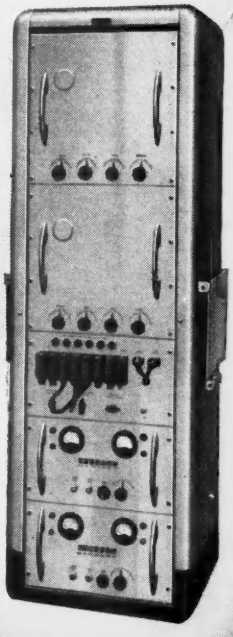
FERRANTI

HIGH SPEED TESTING EQUIPMENT

for A.C. singlephase meters.



One of the slave sub-standard counters which are mounted on a panel below the meters on test.



Conversion equipment supplied separately for modernising existing conventional test equipment.

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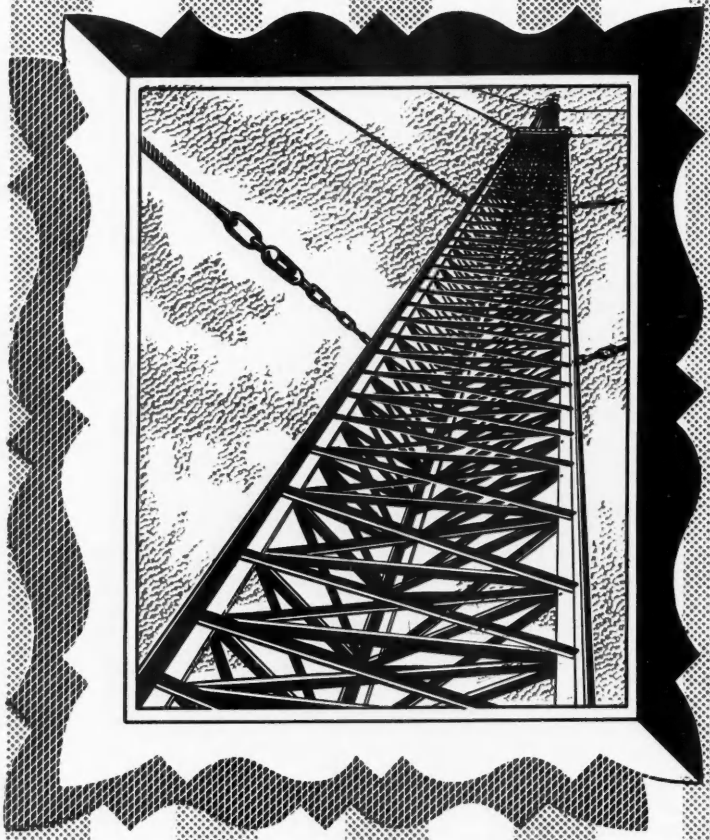

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-Wenvoe,-Holme Moss,-Kirk o' Shotts-

Supplied to the British Broadcasting Corporation and erected by British Insulated Callenders' Construction Company Limited, these three giant television masts are good examples of our work. Such stayed masts are our business and several others are now in hand.

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OVERHEAD ELECTRICAL TRANSMISSION TOWERS AND POLES · RADIO MASTS · CALLENDER-HAMILTON BRIDGES

ELECTRICAL REVIEW

21 January 1955 Vol. 156 No. 3 Established 1872

The Future in India

INDIA with its 360 million population is becoming a new country. Since it achieved self-government conditions have begun to alter very swiftly and the ideas of those interested in Indian industry and trade must be adapted to the new situation as rapidly. The Governments of the Republic and States are endeavouring to raise the living standards of the people and this is involving the provision of electricity on a large scale and the creation of new industries. What part can British electrical manufacturers take in this work and what will be the ultimate effect upon British trade with India?

Considering first the electrification schemes which are being undertaken as part of the Five Year Plans: the first three plans are designed to add 8,700 MW to the country's generating capacity and most of the plant and ancillary equipment will have to be imported. Great Britain has a firm footing but the market is an open one and other countries are displaying a lively interest in it. There seems, however, to be no reason why British manufacturers should not continue to supply a considerable proportion of this heavy plant.

In the industrialization of India, too, there is ample scope for British electrical equipment and for British capital. Projects embodied in the Five Year Plans include the establishment of factories for the production of machinery, textiles, paper, cement, chemicals and other commodities on a large scale. These developments will be financed through the Government-sponsored Industrial Development Corporation and the Industrial Credit and Investment Corporation, with which some of the leading British electrical manufacturers are associated. The latter body has the assistance of the World Bank and the Indian Government and the rest of its capital (initially £14 million) will be raised from Indian, British and American sources.

A specific instance of the international outlook of the Indian Government is presented by the expansion of the Indian steel industry. Already German interests are erecting a steelworks in the State of Orissa and it is now reported that the Government has approved " in principle " a proposal by a British group for the building of another unit for producing 675,000 tons a year. At the same time an offer from Russia to establish a million tons a year plant is under consideration, while a Japanese offer has also been received.

Already a number of the principal British electrical manufacturers are actively producing equipment in their own Indian factories and it would seem that this must be an increasing outlet for British enterprise, to compensate for the decrease in import trade which must inevitably result from India's desire to become self-sufficient. It will take a very long time for this vast expanding country to reach self-sufficiency, if it ever does, and India can be regarded as a customer for our electrical supplies for many years yet. But it will not always be easy going in the face of growing international competition.

EARTHING

Hardly a week passes nowadays without our having to refer in some way or other to the most controversial subject of earthing, whether it relates to equipment in the home or in the factory or on the construction of buildings. Where the human body can be earthed by the surroundings, be they water pipes, gas pipes, non-insulating floorings or building construction steelwork, there can be no argument about the need for efficient earthing. It is often said, however, that earthing can never be guaranteed absolutely effective at any particular moment and we shudder to think how many inadequately earthed electric irons are being used in kitchens with their many possibilities of danger. In particular fields of industry, the coal mine for instance, absolute earthing can be assured by various types of interlocking schemes which often embody special devices and pilot wires the use of which would be uneconomic in the home and in many other spheres of industry. Any appliances, however, can be fitted with a simple and inexpensive means of detecting whether the earthing is operating effectively or not, but this can only be satisfactory if the user is educated to the need to see that the apparatus in use is always properly earthed. It is quite as necessary to educate the public on the safety of electrical apparatus as it is on the uses of the apparatus.

SWINGS AND ROUNDABOUTS

Writing on the financial implications of the railway wages settlement, the political correspondent of the *Yorkshire Post* sets out the accumulated surpluses or deficits of nationalized undertakings, showing a total surplus of £41·5 million from the British Electricity Authority and £8·5 million from the gas industry. Against this he places deficits of £13·6 million for coal and £27·3 million for transport. Thus, he says, over the whole field of the nationalized industries the surpluses are rather larger than the deficits—"a fact which may revive the argument that these basic public services should be considered as a single economic unit." It would be a sad thing if this argument were revived. Such a form of subsidy to unsuccessful industries would be bad not only for those industries themselves but for the successful ones too. They would be encouraged to charge as much for their services as possible, to create sufficient surplus, instead of striving to provide those services to the public as cheaply as possible.

NEW MATERIALS

Evolutionary as has been the progress of engineering in its broad features, it has been greatly accelerated from time to time by the development of new materials or by making fuller use of the potentialities of existing ones. Thus it is some 150 years since metals largely replaced wood and stone and considerably improved structural efficiency. Within the past few years, as Dr. N. J. L. Megson recently pointed out (*Electrical Review*, 4th January), a comparable switch-over has occurred through the activities of chemists in synthesizing compounds of high molecular weight, to produce what are commonly known as plastics. The especial significance of this move is the departure it denotes from sole reliance on the working up of such substances as nature provides, thus enabling new materials to be produced to specifications of actual needs, which should be less wasteful of resources.

CIRCUIT PROTECTION

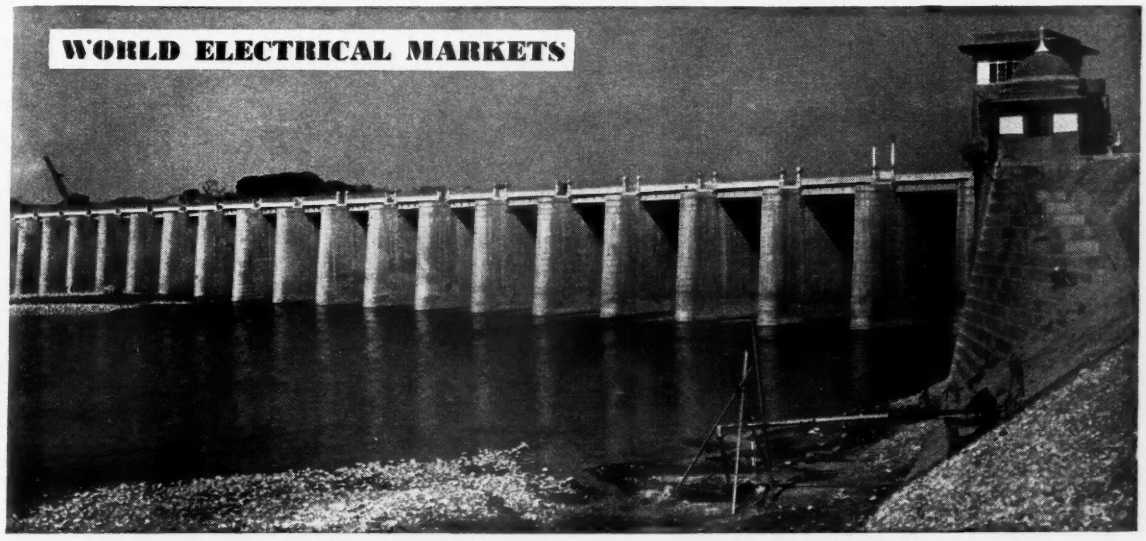
As a substitute for the semi-enclosed fuse and the more expensive high rupturing capacity fuse with its secure safe rating, the miniature circuit breaker has not made the same headway in Great Britain since its introduction about 25 years ago as it has in other countries. Yet, as Messrs. H. W. Wolff and T. G. F. Atherton showed in their I.E.E. paper, summarized on another page, it possesses many advantages in some circumstances. Its chief merit seems to us to lie in avoidance of loss of industrial production through possible delays in the renewal of fuses controlling small motors that may blow on account of transient faults. Where the consequences of interruption of supply are not serious, as on domestic premises generally, their convenience compared with fuses may not be enough to outweigh the higher cost of present designs.

SUPPLY AND DEMAND

Details of electricity generated in this country last year published by the Ministry of Fuel and Power reflect the stimulus given to consumption by the rise in industrial production and by the expansion of sales of electrical appliances which followed the relaxing of hire-purchase restrictions. To some extent, also, the inclement weather of the past summer must have induced people to make greater use of electricity than usual for heating. With the onset of autumn it soon became apparent that the margin between supply and demand remained perilously small, for towards the end of October, when some plant was still out of commission for overhaul, load shedding was again necessary. At that time only about half of the new plant expected to be ready during the year had been brought into service, but fortunately the position was greatly improved during the last two months of 1954 with the result that the prospects for meeting the peak demands in the next few weeks are very much brighter. At the end of the year 20,567 MW of generating plant was installed in stations of the B.E.A. and North of Scotland Hydro-Electric Board, eleven sets totalling 550 MW having been commissioned by the B.E.A. in December.

UGLY OVERHEAD LINES

We have often taken up the challenge when we have heard critics talk of overhead lines spoiling the appearance of the countryside but in a radio interview recently a speaker referred to the unsightliness of overhead lines in villages as the result of poor workmanship. This is another view with which we have much sympathy. There is no need for the ugliness we have seen in some villages and small towns. From a single point overhead lines often radiate in every conceivable direction without the slightest attempt at symmetry and frequently there are two- or three-wire circuits with the wires not even running parallel. Such ugliness as the result of bad workmanship is intolerable and bad for public relations and it is so easily avoided or remedied.



The completed Nangal Dam, designed to provide a balancing storage for the Bhakra power plant ("Indian Trade and Industry")

Progress in India

By R. P. AIYER*

THE first electricity supply undertaking in India it is believed was sponsored by a company which in 1883 constructed a small generating station in the ancient and historic city of Surat. This must have been one of the earliest supply companies in the world. Then followed the erection at the end of the last century of a large station in Calcutta, and in the next two decades public power systems were established in many of the large towns. The year 1902 saw the establishment in Mysore of the first hydro-electric station, followed by the inauguration of the Tata hydro-electric stations near Bombay some time later.

In 1939, before partition, the country had an installed generating capacity of 1·1 million kW with production running to 211 million kWh. Since then development in the private and State sectors has been sustained, resulting in the capacity of the public power systems reaching, on the eve of the commencement of the Five Year Plan in 1950, 1·71 million kW with an annual output of the order of 426 million kWh.

Five Year Plan

The first Five Year Plan laid great emphasis on power development, with a programme of 1·1 million kW of additional generating capacity in the public sector at a cost of Rs. 128 crores.† The private undertakings had plans to add a further 200,000 kW, costing about Rs. 30 crores, including ancillary mains development. Towards the end of 1953 an adjustment was made to the Plan in the public sector involving a further expenditure of Rs. 65 crores during the five-year period. According to the Progress Report for 1953–54 published by the Planning Commission "the achievement up to March, 1954, has been that as a result of the completion of the larger schemes in the Plan additional power capacity to the extent of about 450,000 kW has been added." In the private sector, too, during the first three years of the Plan there has been an addition to the generating capacity of nearly 150,000 kW. At the beginning of 1954 the country had 2·3 million kW of plant available for service in the public supply system with about 600,000 kW in industrial establishments for their own use.

Although power development, as such, as to have lower priority in the second Five Year Plan as many as 54 schemes to be completed by the various State Governments are to find a place in it. Additions to the extent of about 150,000 kW are planned by private concerns.

It is generally believed that power development is mostly a State responsibility with the private sector taking a minor place. Data published by the Central Water and Power Commission at the end of 1952 showed that 220 electricity supply undertakings in the private sector generated 56·2 per cent of the total power against 43·8 per cent by 204 undertakings owned by Government and local authorities. With the completion of the various multi-purpose river valley projects undertaken by various Governments the balance will be tilted in favour of the State Agencies, but nevertheless the private undertakings will be for a long time to come an important source of electric power in India. Furthermore a large volume of the power generated by the Government projects will be distributed by private undertakings.

Electricity Supply Legislation

A reference here to the legislation governing the electric power industry in the country is appropriate.

In September, 1948, the Constituent Assembly enacted the Electricity (Supply) Act "for the rationalization of the production and supply of electricity and to take measures conducive to the electrical development of India."

This Act, by and large, is modelled on the United

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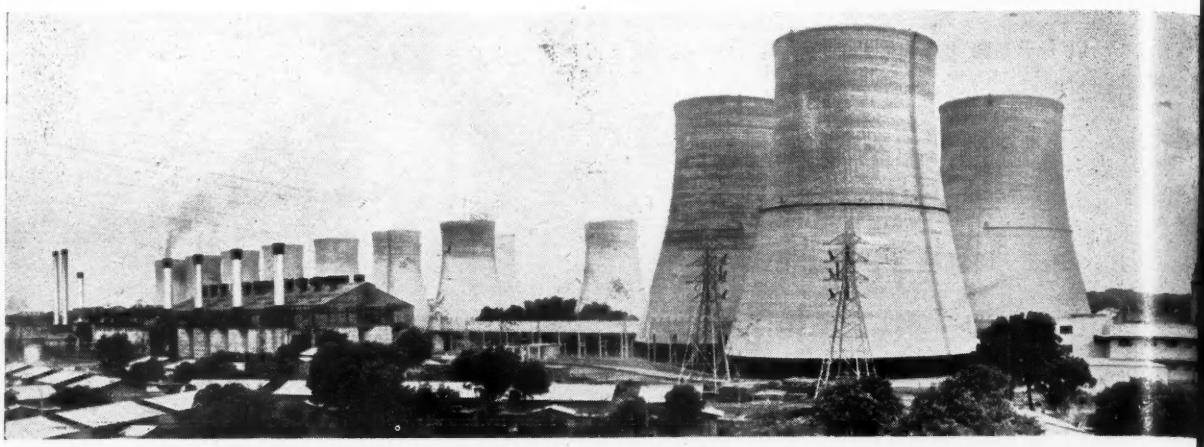
* Secretary, Federation of Electricity Undertakings of India, Bombay.
† A crore of rupees (10 million) = £750,000; one lakh = £7,500.



Panoramic view of the "A," "B" and "C" power stations of the Ahmedabad Electricity Supply Co.

Kingdom Electricity (Supply) Act, 1926. To achieve the basic purpose of the Act, Electricity Boards are to be set up in the States, and these Boards are expected to work in co-operation and in harmony with commercially operated private enterprise. So far Electricity Boards have been constituted in four States, namely, Delhi, Madhya Pradesh, Saurashtra and Bombay.

The Sixth Schedule governing the financial provisions is from the licensees' point of view probably the crux of the measure. In drawing up the Schedule, the framers of the Act are said to have made an exhaustive study of rate regulation practice in the United States, but the Schedule is an entirely new departure and aims at rate regulation by means of legislation instead of through regulation commissions—the American method.

The basic law governing the supply of electrical energy in the country still continues to be the Indian Electricity Act, 1910. An Advisory Board appointed by Government is now engaged in revising the Act and a draft Bill is expected to be placed before Parliament this year. The Rules for carrying out the purposes and objects of the Indian Electricity Act, 1910, are also under revision and a new set is expected to be formulated shortly.

Electrical Manufacture

Although India, even before the Second World War, had a nucleus of electrical manufacturing industries such as dry and storage batteries, certain types of wires and cables, fans, lamps, etc., the growth of electrical manufacturing is mainly a wartime and post-war development. Many of the country's electrical engineering industries have to depend for some of the vital raw materials on imports although attempts are being made to increase internal production. Proposals are also under consideration to establish a heavy electrical equipment industry under State auspices but these are as yet indefinite.

The accompanying tables indicate the growth of electrical manufacture and imports.

MANUFACTURE OF ELECTRICAL MACHINERY AND EQUIPMENT IN INDIA

Class	1946	1947	1948	1949	1950	1951	1952	1953
Conduits (thousand ft)	—	—	1,708	2,948	2,966	3,970	3,695	3,715
Dry cells (lakhs of rupees)	880	880	1,238	1,522	1,381	1,434	1,302	1,484
Storage batteries (thousands) ...	26	70	110	107	187	212	158	176
Electric motors (thousand h.p.) ...	46	38	60	68	82	143	157	163
Power transformers (thousand kVA) ...	40	32	82	109	172	196	215	308
Incandescent filament lamps (thousands)	8,114	7,620	9,252	13,644	14,304	15,516	20,804	19,666
Fluorescent lamps (thousands) ...	—	—	—	—	—	—	76	102
Electric fans (thousands) ...	110	160	180	179	193	212	196	208
Radio receivers (thousands) ...	—	3·0	25·0	16·8	44·3	82·8	71·5	56·3
Bare copper conductors (tons) ...	7,860	—	5,880	5,724	5,676	3,000	5,928	7,368
Winding wires (tons)	216	—	336	336	252	300	396	228
Rubber insulated cables and flexibles (100,000 yd) ...	226	—	220	193	340	412	329	485
House service meters	—	—	—	—	—	—	34·4	80·7
Domestic refrigerators	—	—	—	—	—	—	600	1,140

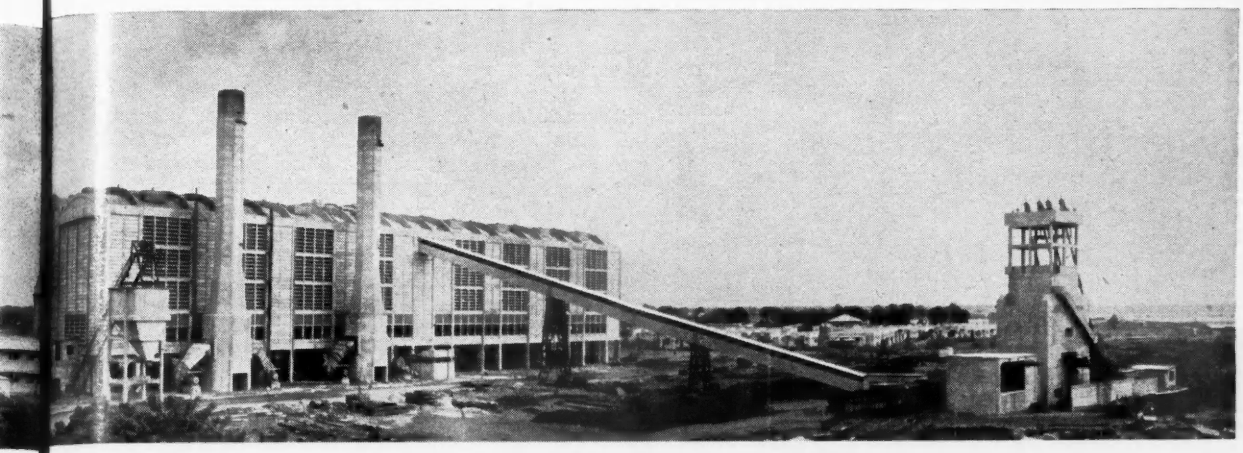
Source: "Monthly Statistics of Production of Selected Industries in India." Director, Industrial Statistics.

The installed capacity and production of power and distribution transformers have been increasing steadily in recent years and simultaneously imports have been steeply rising. The transformer industry was granted protection in 1953 by an increase in the import duty to 10 per cent *ad valorem*. The Tariff Commission has also recommended that "so long as the quality of the domestic transformers continues to be satisfactory and the prices and delivery periods are reasonable, import restrictions should be so administered as to ensure the fullest utilization of domestic capacity," and this recommendation has been accepted by the Government.

The transformer industry has been endeavouring to widen its range and is now producing equipment up to 2,000 kVA and 11 kV on the h.v. side. Transformers of smaller outputs but for voltages up to 33 kV are also being produced. The bulk of the production consists of ratings up to 1,000 kVA and 11 kV on the h.v. side.

The Tariff Commission which inquired into the power and distribution transformer industry in 1952, has in its report shown the need for an additional transformer capacity of about 2,650,000 kVA to utilize the additional power of about 1,334,000 kW to be developed during the first Five Year Plan. This gives an indication of the future transformer requirements of India when the additional 8 million kW of plant visualized in the Five Year Plans comes into use.

The electric motor industry is also of recent growth with the installed productive capacity increasing from 60,000 to over 2,000,000 h.p. in 1953. Production has also expanded, but it is largely confined to motors up to 30 h.p. Besides tariff protection, the Government has been assisting the industry for some time past by restricting imports of three-phase squirrel-cage and slip-ring motors up to 30 h.p. The range of production has been extended and there are schemes for manufacturing machines up to 100 h.p. In 1952 slip-ring motors up to 100 h.p. were manufactured and imports of three-phase squirrel-cage



motors up to 50 h.p. were not permitted. The Planning Commission's estimate of the demand for electric motors by 1955–56 is 320,000 h.p. as against an installed productive capacity which is expected to rise to about 300,000 h.p.

Import Control Policy

Although the import control policy generally has been based on the recognition that the home industry should be fostered, there is general realization that the policy of restriction must be conceived entirely in the national interest and not merely for the manufacturers' benefit. The view is also gaining ground that protection for Indian industry should be framed more and more on inquiries by the Tariff Commission rather than on the dubious and improper method of haphazard control. Nevertheless import control has been a vital factor in the development of small-scale electrical goods industries.

Overseas Suppliers

The bulk of the heavy electric plant imported in the past has been from British manufacturers, but Swiss, Swedish and German concerns have participated in the business. In the great multi-purpose river valley projects undertaken by the State Agencies most of the heavy electric plant has been supplied by the Americans. Japanese manufacturers of generating plant and boilers have obtained contracts and German concerns have successfully tendered for the big Trombay thermal project under construction by Tatas.

IMPORTS OF ELECTRICAL MACHINERY OF ALL KINDS

(Value in thousands of rupees)

Class	1944–45	1945–46	1946–47	1947–48	1948–49	1949–50	1950–51	1951–52	1952–53	1953–54
Control and switchgear	6,158	9,501	11,599	17,907	26,817	45,017	37,022	43,937	54,836	56,974
Generators	2,468	3,312	9,397	19,323	21,794	21,654	15,630	29,395	24,630	40,837
Motors	4,398	6,973	9,578	17,659	31,474	25,232	14,104	11,448	12,290	14,370
Transformers	1,344	3,784	4,292	4,781	10,998	14,138	15,353	17,783	14,425	19,423
Turbo-generating sets	968	596	2,242	3,848	3,445	5,976	6,469	15,239	12,984	7,651
Other	5,018	7,980	14,623	17,807	33,287	35,276	31,409	58,183	52,320	49,517
Totals	20,354	32,146	51,731	81,325	127,815	147,293	119,987	175,985	171,485	188,772

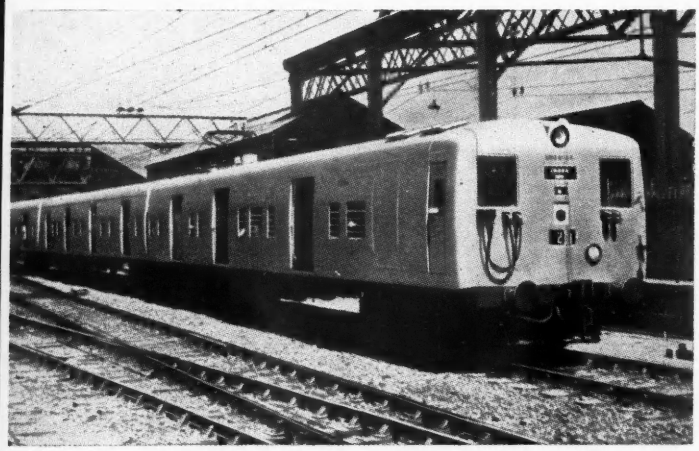
Source: " Seaborne Trade and Accounts," Director-General, Commercial Intelligence and Statistics.

IMPORTS OF ELECTRICAL INSTRUMENTS, APPARATUS AND APPLIANCES AND PARTS

(Value in thousands of rupees)

Class	1944–45	1945–46	1946–47	1947–48	1948–49	1949–50	1950–51	1951–52	1952–53	1953–54
Electric fans and parts	191	86	1,896	2,615	212	684	323	551	446	683
Electric wires and cables	9,778	18,041	16,179	28,603	42,493	52,688	41,173	34,384	77,040	71,900
Telegraph and telephone instruments and apparatus	1,771	4,075	3,865	3,033	3,892	5,356	10,950	3,745	3,851	4,884
Gasfilled electric lamps	1,765	7,550	2,323	2,048	2,665	3,234	638	688	389	358
Vacuum electric lamps	416	1,236	698	1,050	1,292	1,233	67	48	160	75
Electric lamps for automobiles ...	81	55	52	401	1,004	453	442	3,205	1,981	13
Electric torch lamps	171	787	2,182	1,322	1,652	2,101	1,226	2,703	1,899	1,801
Electric lamps, other	66	1,062	6,397	9,566	9,538	16,424	2,788	1,648	2,881	2,808
Parts and accessories of electric lamps	60	151	392	1,535	3,199	3,687	1,148	693	967	701
Batteries	110	512	617	1,361	1,929	4,026	1,700	2,426	1,648	1,531
Carbons, electric (including furnace) ...	567	1,114	778	1,050	2,015	2,000	3,485	5,148	2,226	3,372
Accumulators and parts	1,276	1,207	1,846	1,974	1,331	2,915	2,431	4,050	2,960	1,280
Condensers, electric	227	499	295	679	441	314	229	508	557	527
Electric bell apparatus (not telegraphic or telephonic)	53	95	645	285	224	300	327	134	142	315
Electric lighting accessories and fittings (including switches) ...	379	537	1,798	9,487	7,866	5,085	2,080	5,025	4,997	4,973
Electrical instruments (other than telegraphic and telephonic) ...	780	1,730	5,613	10,253	12,972	10,143	8,094	13,126	8,795	7,452
Electro-medical apparatus (including X-ray)	514	794	1,367	3,104	3,138	2,605	3,446	3,629	2,872	3,342
Switchboards	267	529	612	428	1,832	2,467	1,568	1,044	526	1,064
Electrical porcelain ware	163	95	180	189	169	375	257	547	443	908
Electrical goods n.e.s....	2,404	5,173	11,831	18,896	16,513	14,866	14,302	25,008	29,626	22,405
Total	21,039	45,328	59,566	97,879	114,375	130,216	96,674	108,311	138,142	130,398

Source: " Seaborne Trade and Accounts," Director-General, Commercial Intelligence and Statistics.



Streamlined coaches for Indian electric railways ("Indian Trade and Industry")

British manufacturers have, however, continued to supply most of the electrical goods required by India and there is no reason to think that this lead will be lost. The goodwill established in the country by leading United Kingdom manufacturers is a factor to be reckoned with, and the agency arrangements they have in the country cannot be said to be deficient. Service after supply and installation of plant cannot, however, be said to be fully adequate, with certain notable exceptions.

The technical bulletins issued by leading British manufacturers give an indication of the technological development in their particular fields and they are well appreciated. Their wider distribution so as to reach a larger section of the industry and public would be of advantage to the trade. This includes technical colleges and institutes where lectures by visiting works specialists are always highly appreciated.

At the end of 1952 India had 170,260 kW of diesel plant and this is likely progressively to become surplus with bulk power becoming available from the river valley projects. However, it may be useful for installation at "nursery schemes" where the benefits of "grid" supplies are not expected to be available for some years. This reserve of plant in the country will be a deterrent to the importation of new diesel plant and there may even be endeavours to export part of this plant to neighbouring overseas markets.

Scope for Future

The development of sources of power supply both in the public and private sectors occupies an important place in the scheme of the National Plan. Increasing attention is also being given to the importance of using the power thus made available and quite recently the Planning Commission sanctioned loans totalling Rs. 18.24 crores to thirteen States for rural electrification.

Use of electric power pre-supposes the necessity for electrical apparatus and even in this field there is a wide market which Indian manufacturers cannot hope to satisfy successfully for some years to come. The expansion in generating capacity visualized in the first three Five Year Plans is of the order of 8·7 million kW which will necessitate the import of a vast quantity of heavy electrical plant and other equipment, and with the long association the country's electricity supply industry has had with United Kingdom manufacturers there is no reason why the latter should not continue to play as important a part in India's future electric power development as they have done in the past.

Research and Technological Education

GIVING the annual address to the Bradford Textile Society on 10th January Sir George Nelson, chairman of the English Electric Co., Ltd., mentioned that since 1948 the exports of this country had increased annually by 5 per cent and he saw no reason why they should not continue to increase if proper attention was given to research and development. He stressed the need for more and more research to find substitutes for the world's irreplaceable minerals. The resources of iron and coal might last 100 years, but some substitute would have to be found in less than this time. The world looked to nuclear energy to supply the needs of the future and although research was directed on these lines he did not think it would come as soon as some people thought.

His own large group of companies was giving practical support in the search for more scientific knowledge and in 1953 had spent £11 million on research and development. He urged that Great Britain should not try to compete in the low standards of production, except possibly for the home trade, but for an expansion of the export trade it was necessary for industrialists to apply their resources to the production of goods needing greater skill, and labour displaced in the lower grade goods industries should be absorbed in the more skilled industries.

Commenting on education and industry he complained that the implementation of the recommendations of the Percy Committee on Higher Technological Education had been most sadly delayed by the Ministry of Education. The great technical Institutions of Civil, Electrical and Mechanical Engineers, the Federation of British Industries and many individual trade associations had all been pressing to ensure a sufficient supply of technicians even for the country's present needs. The recent report of the Advisory Council on scientific policy stated that Britain needed more business men who appreciated the scientific approach, but Sir George thought that what was really needed were scientists and technical personnel who had the qualities necessary to become successful business men.

The Lord Mayor of Bradford (Alderman H. J. White), seconding a vote of thanks to Sir George, drew attention to the position of the Bradford Technical College which could train the technological experts called for by Sir George as well as any university in the country but which had not yet received the recognition Bradford felt it should have.

Coal Research

THE Cadman Memorial Lecture was delivered to the Royal Society of Arts on 19th January by Dr. W. Idris Jones (National Coal Board), who gave an account of the basic and applied research now being carried out by the British coal industry. The most important single change effected by nationalization he regarded as the appointment to the Board of a scientific member (Sir Charles Ellis, F.R.S.). About 2,500 persons were engaged on scientific control at a cost of 1·4d per ton and 700 on research for 1·0d per ton. In addition a considerable sum was spent on production and engineering development. About 140 separate investigations were in hand, including 40 at 12 universities, apart from those being undertaken by research associations to which the Board subscribed. Among the particulars given were those relating to new methods of coal processing and carbonization under investigation.

RELAXATION METHODS — I

Application to Electric Field Problems

By HUGH McKIBBIN, M.Sc.

THE basic principles of applying relaxation methods to electric field problems were given in an earlier article published in the *Electrical Review*, 10th and 24th July, 1953. The purpose of this series of articles is first to show how relaxation methods can be applied to more difficult electric field problems and second, to treat in more detail some points of technique inadequately covered in the first article.

Since engineers must, from necessity, use components of many shapes it is impossible to choose a relaxation net for every problem which will give full-length meshes everywhere in a domain. The first step will be, therefore, to derive a residual equation which will enable us to deal with "unequal" or "irregular stars," i.e., nodes with fractional meshes emanating from them.

General Residual Equation

Consider a node o, Fig. 1, of a square-meshed net, covering the domain of an electric field, from which emanate two fractional meshes, oX and oY, and two full-length meshes, o3 and o4. If the lengths of oX and oY are ph and qh respectively, where $o < (p \text{ or } q) \leqslant 1$, then using Taylor's series we may write

$$V_X = e^{ph\frac{\partial}{\partial x}} V_0 = (1 + ph\frac{\partial}{\partial x} + \frac{p^2h^2}{2!}\frac{\partial^2}{\partial x^2} + \ldots.) V_0$$

$$\text{and } V_Y = e^{qh\frac{\partial}{\partial y}} V_0 = (1 + qh\frac{\partial}{\partial y} + \frac{q^2h^2}{2!}\frac{\partial^2}{\partial y^2} + \ldots.) V_0$$

where V is the electric potential.

Similarly

$$V_3 = e^{-h\frac{\partial}{\partial x}} V_0 = (1 - h\frac{\partial}{\partial x} + \frac{h^2}{2!}\frac{\partial^2}{\partial x^2} - \ldots\ldots) V_0$$

and

$$V_4 = e^{-h\frac{\partial}{\partial y}} V_0 = (1 - h\frac{\partial}{\partial y} + \frac{h^2}{2!}\frac{\partial^2}{\partial y^2} - \ldots\ldots) V_0.$$

Forming the sums $(V_X + pV_3)$, $(V_Y + qV_4)$ and neglecting third and higher order terms we find that

$$(V_X + pV_3) \approx (1 + p) V_0 + \frac{1}{2} p (1 + p) h^2 \left(\frac{\partial^2 V}{\partial x^2}\right)_0$$

$$\text{and } (V_Y + q V_4) \approx (1 + q) V_0 + \frac{1}{2} q (1 + q) h^2 \left(\frac{\partial^2 V}{\partial y^2}\right)_0.$$

Hence

$$\left(\frac{\partial^2 V}{\partial x^2}\right)_0 \approx \frac{1}{2h^2}\left[\frac{V_X}{p(1+p)} + \frac{V_3}{(1+p)} - \frac{V_0}{p}\right] \quad \ldots.(1)$$

$$\text{and } \left(\frac{\partial^2 V}{\partial y^2}\right)_0 \approx \frac{1}{2h^2}\left[\frac{V_Y}{q(1+q)} + \frac{V_4}{(1+q)} - \frac{V_0}{q}\right] \quad \ldots.(2)$$

And if the electric potential V satisfies Laplace's equation in two dimensions, viz.

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} = 0, \quad \ldots.(3)$$

we may, by substituting (1) and (2) in (3), write, for the residual equation at node o in Fig. 1,

$$F_0 \equiv \frac{V_X}{p(1+p)} + \frac{V_Y}{q(1+q)} + \frac{V_3}{(1+p)} + \frac{V_4}{(1+q)} - \left(\frac{1}{p} + \frac{1}{q}\right) V_0 \approx 0 \quad \ldots.(4)$$

When $p = q = 1$ equation (4) becomes the "standard" residual equation for a node from which four full meshes emanate, namely

$$F_0 \equiv (V_1 = V_X) + (V_2 = V_Y) + V_3 + V_4 - 4V_0 \approx 0 \quad \ldots.(5)$$

In practice a net which produces more than two fractional meshes at any node is regarded as being too coarse; equation (4) can therefore be regarded as the general residual equation.

Illustrative Problem

A problem, to illustrate the application of equation (4), can be conveniently formulated by replacing the square core of the conductor arrangement used in the earlier article by a circular one of diameter 2 units. The potentials on the core and sheath will, as before, be fixed arbitrarily at 1,000 and zero. Fig. 2 shows the arrangement.

By making use of the symmetrical disposition of the conductors about the horizontal and vertical centre lines and also about the diagonals of the square sheath, the computation can be confined to one eighth of the domain.

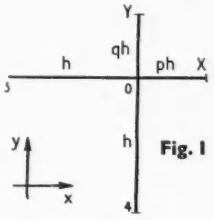


Fig. 1

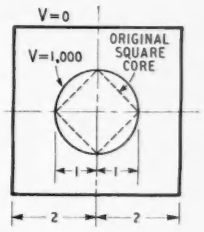
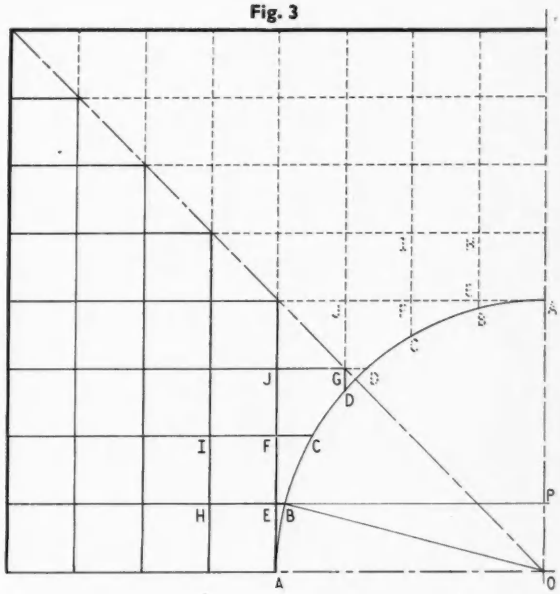


Fig. 2

Fig. 3



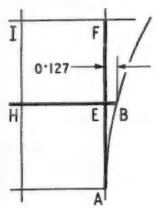


Fig. 4

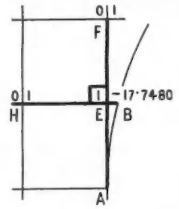


Fig. 5

Using a net of mesh length $h = \frac{1}{4} \times$(core radius) we find that there are three nodes from which fractional meshes emanate. These are, referring to Fig. 3, E and F with one fractional mesh each, EB and FC respectively, and G with two fractional meshes, GD. The fractions which EB, FC and GD are of a whole mesh length are easily found using Pythagoras's theorem as follows. In the right-angled triangle OPB, Fig. 3, $PB^2 = (OB^2 - OP^2)$ and OB being the radius of the circular core equals four mesh lengths, i.e., OB = 4h, also OP = h, so that $PB = h\sqrt{15} = 3{\cdot}873h$, but PE = 4h so that $EB = (4 - 3{\cdot}873)h = 0{\cdot}127h$. Similarly $FC = 0{\cdot}536h$ and $GD = 0{\cdot}354h$.

Consider node E, shown separately in Fig. 4. A comparison with Fig. 1 will show that nodes EBFHA, in Fig. 4, correspond to nodes oXY34, in Fig. 1. We have, therefore, for node E, p = 0·127 and q = 1. Substituting in equation (4) we get

$$F_E \equiv \frac{V_B}{0{\cdot}127 \times 1{\cdot}127} + \frac{V_F}{2} + \frac{V_H}{1{\cdot}127} + \frac{V_A}{2} - \left(\frac{1}{0{\cdot}127} + 1\right) V_E \approx 0$$

$$\equiv 13{\cdot}9734V_B + V_F + 1{\cdot}7746V_H + V_A - 17{\cdot}7480V_E \approx 0.$$

(A multiplier of 2 was introduced for convenience.)

Now the core potential has been specified as 1,000 therefore $V_A = V_B = 1{,}000$. The final form of the residual equation for node E is therefore

$$F_E \equiv 14{,}973{\cdot}4 + V_F + 1{\cdot}7746V_H - 17{\cdot}7480V_E \approx 0 \quad ..(6)$$

The residual equations for nodes F and G are obtained by similar means. They are

$$F_F \equiv 2{,}429{\cdot}3 + 1{\cdot}3021V_I + V_E + V_J - 5{\cdot}7314V_F \approx 0 \quad ..(7)$$

$$F_G \equiv 4{,}172{\cdot}6 + 1{\cdot}4771V_J - 5{\cdot}6497V_G \approx 0 \quad ....(8)$$

In obtaining equation (8) account has been taken of the symmetry about the diagonals.

Relaxation Patterns

Initially difficulties may be encountered in forming the relaxation patterns associated with nodes like E, F and G in Fig. 3. They can be overcome completely by tabulating the relevant residual equations (the "operations table," see below) so that the relaxation patterns are obtained automatically, but this method obscures the basic principles of relaxation methods. The beginner is, therefore, recommended to "make haste slowly" by forming individual relaxation patterns at first. He can then advance to "mechanical computations" with a sound knowledge of the underlying principles.

The relaxation patterns for nodes E, F and G will now be determined. Consider node E. Any displacement made at node E will produce changes in the residuals at nodes E, F and H, because V_E is used in calculating the residuals at these nodes (see equations (5), (6) and (7); equation (5) holds for node H). Making a unit displacement, $\triangle V_E = 1$, at node E we find that the corresponding changes in the residuals at nodes E, F and H are $\triangle F_E = -17{\cdot}7480$, $\triangle F_F = 1$ and $\triangle F_H = 1$ respectively. These results are summarized in Fig. 5. In like manner we find that unit displacements at the nodes F and G produce the relaxation patterns shown in Fig. 6.

In addition to these three special relaxation patterns there are three others for the nodes H, I and J. This is because the displacements made at these three nodes are used to calculate the residuals at nodes E, F and G; see equations (6) to (8). The relaxation patterns for these nodes are given in Fig. 7. It should be noted that the standard residual equation (5) is used to calculate the residuals at nodes H, I and J, as it is at *all* the remaining nodes in the domain.

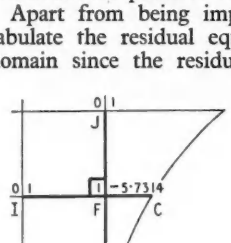
The Operations Table

As was stated above it is possible to use an "operations table" instead of relaxation patterns. When there are few special residual equations there is little to choose between the two methods, but with large numbers of special equations tabulation is simpler. To illustrate the method of drawing up an operations table the special equations required for the present problem are shown tabulated in Table 1.

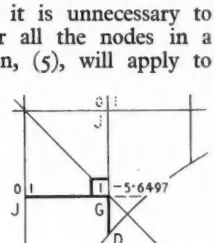
Residual equations are obtained from the operations table by reading horizontally. A comparison between equations (6), (7) and (8) and the first three lines of Table 1 will show this clearly.

Relaxation patterns are obtained by reading vertically, e.g., the residual changes produced by a unit displacement, $\triangle V_E = 1$, at node E (Fig. 3) are, from the column headed V_E, $\triangle F_E = -17{\cdot}7480$, $\triangle F_F = 1{\cdot}0000$ and $\triangle F_H = 1{\cdot}0000$, which are exactly the same as those given in Fig. 5. Further comparisons between the remaining vertical columns in Table 1 and Figs. 6 and 7 will make the method of deriving the relaxation patterns clear.

Apart from being impracticable it is unnecessary to tabulate the residual equations for all the nodes in a domain since the residual equation, (5), will apply to

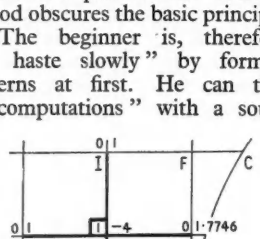


NODE F

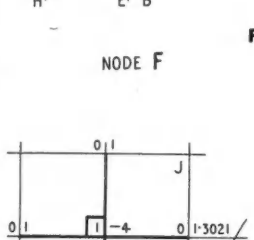


NODE G

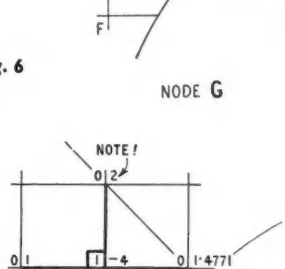
Fig. 6



NODE H



NODE I



NODE J

Fig. 7

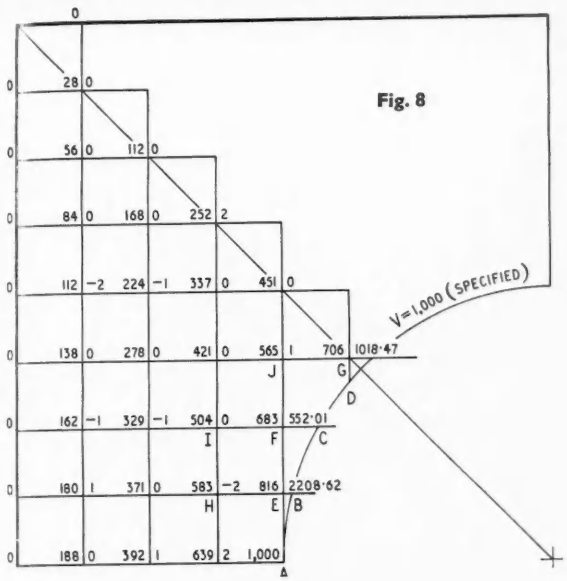


TABLE 1

	V_E	V_F	V_G	V_H	V_I	V_J	Constant
FE	−17·7480	1·0000		1·7746			14,973·4
FF	1·0000	−5·7314			1·3021	1·0000	2,429·3
FG			−5·6497			1·4771	4,172·6
FH	1·0000			−4·0000	1·0000		
FI		1·0000		1·0000	−4·0000		
FJ		1·0000	1·0000			−4·0000	

many nodes. Complete residual equations (and relaxation patterns) for nodes like H, I and J in Fig. 3 are therefore not listed in the operations table: compare Fig. 7 and Table 1.

Starting the Solution

After the operations table has been drawn up the next step is to assign an initial value for the electric potential V to each node at which a value has *not* been specified and calculate the residuals. With this type of problem (the "fixed-boundary" type) the final solution is inevitable whatever values of V are assigned initially to the nodes between the fixed boundaries, but obviously the more nearly the initially assigned values approximate to the correct values the smaller will be the amount of computation required.

In the present problem three obvious methods of starting suggest themselves; they are:—

(i) put V = 0 at all nodes;
(ii) estimate values for V by starting with a very coarse net and advancing to finer nets;
(iii) use the solution obtained with the square core as the "initial guess."

Since the first two methods have already been dealt with in the earlier article the third method will be used to illustrate how irregular stars modify the relaxation process. There would, of course, be no difference in principle if either of the other two methods were used. The reader is advised to confirm this.

Fig. 8 shows the residuals obtained using the "square-core" solution as the "initial guess." To make the method of obtaining residuals at unequal stars quite clear the residual calculations for nodes E, F and G are given in detail below.

From the first horizontal line in Table 1 or equation (6) we have

$F_E \equiv -17{\cdot}7480V_E + V_F + 1{\cdot}7746V_H + 14{,}973{\cdot}4$

and from Fig. 8 we see that $V_E = 816$, $V_F = 683$ and $V_H = 583$, therefore

$F_E \equiv -(17{\cdot}7480 \times 816) + 683 + (1{\cdot}7746 \times 583) + 14{,}973{\cdot}4 = 2{,}208{\cdot}62.$

Similarly

$F_F \equiv 816 - (5{\cdot}7314 \times 683) + (1{\cdot}3021 \times 504) + 565 + 2{,}429{\cdot}3 = 552{\cdot}01,$

and

$F_G \equiv -(5{\cdot}6497 \times 706) + (1{\cdot}4771 \times 565) + 4{,}172{\cdot}6 = 1{,}018{\cdot}47.$

The residuals at *all* other nodes are calculated using the standard residual equation (5). Thus, for example,

$F_H \equiv 816 + 504 + 371 + 639 - (4 \times 583) = -2$
$F_I \equiv 683 + 421 + 329 + 583 - (4 \times 504) = 0$
$F_J \equiv 706 + 451 + 421 + 683 - (4 \times 565) = 1$

and so on for the remaining nodes.

Liquidation of Residuals

To illustrate the liquidation process at and around an unequal star consider node E in Fig. 8. The residual at this node is 2,208·62. From Fig. 7 or Table 1 we know that for each unit displacement, $\triangle V_E = 1$, made at node E there is a corresponding change of −17·7480 made in the residual at E. Therefore, to liquidate the residual of 2,208·62 at E we must make $(-2{,}208{\cdot}62/-17{\cdot}7480) \approx 124$ unit displacements at E, i.e., make a total displacement $\triangle V_E = 124$ at E.

Now the relaxation pattern for node E (Fig. 5 or Table 1) shows that, as well as producing a change of −17·7480 in the residual at E, a unit displacement at E also produces unit changes in the residuals at nodes F and H. Therefore, the displacement $\triangle V_E = 124$, which is necessary to liquidate (approx.) the residual 2,208·62 at node E, increases the residuals at F and H by amounts $\triangle F_F = 124$ and $\triangle F_H = 124$. The residuals at nodes E, F and H thus become

TABLE 2

	Original Residual	Change Produced by $\triangle V_E = 124$	New Residual
$F_E \equiv$	2,208·62	− (17·7480 × 124)	= 7·87 ≈ 8
$F_F \equiv$	552·01	+ (1 × 124)	≈ 676
$F_H \equiv$	− 2	+ (1 × 124)	= 122

These changes are shown entered up in Fig. 9.

In the early stages of liquidation decimals in both residuals and operators are best ignored. This enables the initial computation to be carried out mentally, which helps to speed up the process. This policy has been partially followed in the above calculations. Actually −17·7480 would be called −18 and −2,208·62 called

Fig. 9

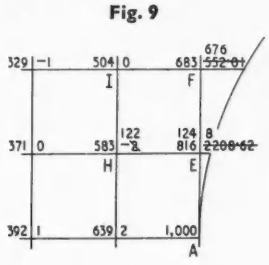
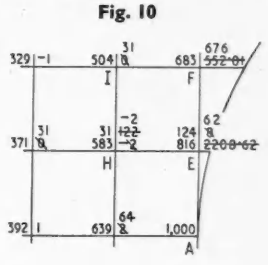


Fig. 10



$-2{,}209$, then $\triangle V_E \approx 2{,}209/18 \approx 123$; so by this method

$\triangle F_E = 2{,}209 - (18 \times 123) = -5$

$\triangle F_F = 552 + 123 = 675$

$\triangle F_H = -2 + 123 = 121.$

Obviously this method will produce errors in the residuals but as residual checks must be made anyway as the solution progresses any errors incurred through these approximations do not matter greatly. Residuals must be liquidated as quickly as possible and any method which speeds up the liquidation process is to be welcomed.

Consider node H now, Fig. 9. Suppose we wish to liquidate the residual of 122 at this node.* The standard residual equation (5) applies to node H so to liquidate the 122 we must make a displacement of $\triangle V_H = (-122/-4) \approx 31$ at H. Doing this we find that the residual at H becomes

$F_H = 122 + (-4 \times 31) = -2,$

the residual at E becomes

$F_E = 8 + (1{\cdot}7746 \times 31 \approx 1{\cdot}8 \times 30) \approx 62$

while the residuals at node I and at the two nodes occupying the "node 3" and "node 4" positions relative to H become

$F_I = 0 + 31 = 31$

$F_3 = 0 + 31 = 31$

$F_4 = 2 + (2 \times 31) = 64.$

(*Note.*—Node 4 relative to H lies on an axis of symmetry, hence $\triangle F_4 = (2 \times 31)$.)

Fig. 10 shows the residuals, etc., at this stage of the solution.

(*To be concluded*)

* The sequence of operations given here is intended to illustrate only the liquidation process, not good or bad relaxation practice. To discuss what constitutes good and bad relaxation practice would confuse rather than help the beginner. I am concerned only to demonstrate the chief tools at his disposal. He will develop his own technique by experience.

Valves for the Services and Industry

WHEN he opened the discussion on the I.E.E. paper on thermionic valves of improved quality for Government and industrial purposes (see page 58 of our last issue) Dr. J. Thomson stressed the complexity of the problem of improving quality, particularly as one factor influenced every other factor. The greatest success would be achieved by the engineer who scored the highest aggregate mark for all the factors involved, but unfortunately one militated against another; accurate quality control, for instance, against mechanization, and so on.

Dr. G. R. Metson (P.O. Research Station) said that for him improved quality meant longer life. The title of the paper might therefore be paraphrased as "longer life valves for those who can afford them." Apparently long life and reliability were not compatible and it would be long before a valve would see out a television set. The main points were to understand the properties of the metals, the assembling of the parts, and the putting of a reasonable life into the mechanical structure.

Air Marshal Sir R. Owen Jones (Air Ministry) congratulated the authors on their excellent results. Reliable equipment was very helpful at a time when skilled men were difficult to obtain and to train.

Mr. R. H. Collcutt (Air Ministry) gave figures for tests made during normal working to compare the behaviour of reliable type and ordinary valves on standard v.h.f. transmitters and receivers. He thought the point had now been reached in airborne sets where valves would no longer be a major source of trouble.

Mr. F. M. Walker (Mullard, Ltd.) congratulated the authors on the timeliness of their summary of the position, when several factories had just obtained a reasonably satisfactory and steady production of special valves meeting the full service specification. The importance of ensuring that higher reliability was consonant with mass production in time of emergency must not be overlooked.

Mr. R. Brewer (G.E.C. Research Laboratories) confirmed the percentage life figures given in the paper but questioned whether a big enough sample had been taken. A sounder indication of reliability might perhaps be given by percentage survivors, though percentage life was useful in trunk communication systems.

Mr. K. Hopkinson (R.R.E.) said published reports indicated an almost equal division between mechanical and electrical failures, the latter having no justification in many cases. Government establishments regarded C.V. specifications very seriously and thought they should be detailed and comprehensive. They had spent much time in investigating test methods.

Mr. M. B. Williams (P.O. Engineering Department) thought users should be clear as to the meaning of failure. In his experience there were two kinds, those which cut off the service in a long line of amplifiers and those which indicated that the panel or amplifier had gone outside the specification limits. The latter involved a great deal of maintenance effort in locating the fault and putting it right. The long life valve was most desirable as a means of saving maintenance time and effort.

Mr. R. E. B. Wyke (M.O. Valve Co.) urged educational establishments to devote more attention in vocational courses to explaining what made valves work and stop working. He supported the authors' plea for wired-in valves.

Mr. M. H. R. Reid said it was realized on the supply side that developments would take a long time to put into production. There had therefore been full consultation between the supply departments and the development side to secure a specification embracing the mechanical features essential to reliable valves.

Mr. D. C. Birkinshaw (B.B.C.) said there were 18,000 valves at Lime Grove, which confirmed his view that it was worth two battleships. Half of them were replaced every year, but he did not know whether that was good or bad. It was liable to cause more breakdowns in the service than was desirable, however, and the figures suggested that some progress was wanted.

Mr. P. Lewis put in a plea for a reliable valve holder and suggested that multiple spring contacts might give better service.

Mr. G. I. Hitchcox pointed out that wired-in valves would not be much use to an industrial customer who was not in the electrical field, because of the difficulty of changing them.

Mr. F. W. Irons, speaking as a valve holder manufacturer, pointed out that a good deal of work was being done on the design and development of special holders for wired-in valves with particular attention to the dissipation of heat.

Mr. L. R. Mullin (Marconi) thought the only way to get reliable valves after doing away with early failure was to produce valves with a very long life in order to obtain trouble-free operation.

I.E.E. ANNUAL DINNER

THE annual dinner of the Institution of Electrical Engineers will be held at Grosvenor House, Park Lane, London, W.1, on 24th February (7 for 7.30 p.m.). Members wishing to attend are advised to apply for tickets to the secretary of the Institution as soon as possible.

Engineering in Europe

Abstracts from Foreign Technical Journals

THE fact that carrier-wave communications equipment is connected to the power systems through coupling capacitors and that the practice of h.v. measurements at voltages exceeding 110 kV increasingly uses capacitive instead of inductive voltage transformers for economic reasons makes it worth while to try to combine the elements serving these two different purposes into a single unit. The lead taken by Sweden and the United States in this respect is now being followed in Germany.

The author considers the possible coupling and decoupling circuits for these purposes and the advantages of the joint use of the capacitive voltage transformers, particularly for the carrier-wave transmission. These consist in the possibility of using duplex coupling and wide-band coupling, enabling the whole band width from 50 to 300 kc/s to be utilized for communications without excessive outlay for coupling elements and, lastly, and in the possibility of decoupling two interconnected power systems over a considerable part of the available frequency range. The minimum capacitances of the h.v. capacitors required for these purposes are 2,200 pF in the first, 4,400 pF in the second, and 10,000 pF in the third case, and they will serve as capacitive measuring transformers as well.—"Capacitive Voltage Transformers in Carrier-Wave Communications Equipment for Power Systems," H. K. Podszeck, *E.T.Z.* (A), Vol. 75, No. 19, pp. 668–671, 1st October, 1954, in German.

Ageing of Oils

The oils used for filling Pirelli cables are intrinsically different from those used in compound-filled cables, mainly by being highly fluid, whereas the latter are highly viscous, corresponding to the very different uses made of them in the two types of cables. The oil in Pirelli cables must circulate, while that in compound cables should not move. Also, the electrical stresses in Pirelli cables are much higher (they are used up to 380 kV). In general, the ageing properties of the oils in Pirelli cables are excellent over service periods up to 20 years and more, provided the cables are not overloaded. However, under frequent heavy overloads the oil will deteriorate and oxidation, wax formation and precipitations will occur, but the character of these deteriorations is still fundamentally different from the corresponding processes in compound-filled cables. Above all, no metal soaps nor sludges are formed, and the wax differs from that forming in viscous oils.

A testing method evolved by the author could shed some light on the mechanism of the deterioration of the oil under overloads, since the main contaminations of the oil consist of "ashes," these being largely composed of iron and lead oxides (organic metal compounds). Organoferric compounds may, according to a thesis of Piper, constitute the centre of a conducting macro-molecule in the oil. The volume of this macro-molecule increases by adsorption of other constituents of the oil and owing to this the conductivity of the oil increases. It should also be noted that iron is a catalyst of oxidation and copper a catalyst of polymerization and that the high operating temperatures obtaining under overloads stimulate partial decomposition and oxidation of the oil even in the absence of atmospheric oxygen. The author concludes by stipulating the conditions for insulating oils of increased thermal, chemical and dielectric stability.—"Some New Observations on the Ageing of the Oils for Pirelli Cables during Service," T. Salomon, *Bull. Soc. Franc. Elect.*, 7th Ser., Vol. 4, No. 46, pp. 557–569, October 1954, in French.

Insulator Surface Resistance

Investigations into the relation between surface resistivity of glass, ceramics and plastics and the moisture content of ambience revealed a sudden reduction of the surface resistivity between 60 and 90 per cent relative humidity. This severely limits the effectiveness of insulators made from these materials when used in damp atmospheres.

It is known that silico-organic protective coatings of the insulators improve these conditions, but these organic compounds have a poor mechanical strength. It was therefore of interest to investigate the effect of the shape of the insulators on the maintenance of a high surface resistance in wet atmospheres. Insulators with sheds have long been known to be more satisfactory than smooth types and a tentative interpretation of this fact sometimes advanced was that the sheds interrupted the polymolecular water layer formed on the insulator surface (at a relative humidity of 98 per cent and 20 deg C, this layer corresponds to about 180 mono-molecular layers). However, the experiments could disprove this assumption and at the same time supply the correct explanation.

The solution of the problem was obtained by tests in which the convex and concave portions of the sheds were coated in turn with a semi-conducting varnish. In the first case the surface resistance after five days in an ambience of 98 per cent relative humidity was still 2×10^{19} ohms, in the second it dropped to 5×10^{9} ohms. This proves that the surface resistance of this insulator type is "localized" in the concave portions of the insulator surface, the most likely explanation of this fact, which is independent of the insulator material, being the weakening of the tangential component of the field strength at these points.—"Effect of the Shape of an Insulator on its Surface Resistance," L. N. Zakgeim and N. D. Polteva, *Zh. tekh. Fiz.*, Vol. 24, No. 7, pp. 1205–1208, 1954, in Russian.

Fuse Design

Fuse design must always lead to compromises between the characteristics of short-circuit-proofness, selectivity, continuous load capacity, temperature rise, etc. It is comparatively easy to develop one of the desirable characteristics at the expense of the others but very special designs of fuse elements must be used to combine several desirable properties. The problem is further complicated by the fact that the response of the fuse should be fast in a certain range of currents and slow in an adjacent range, and generally the required fuse characteristics will depend on the characteristics of the circuits to be protected; for example, circuits supplying appreciable numbers of motors operated intermittently must be protected by fuses of a certain overload capacity.

Selectivity of fuse protection will generally only be achieved by fuse combinations in which more or less contradictory requirements are satisfied by different fuse

types series-connected, whereas the design of the individual high-duty fuses is more and more based on what amounts to parallel-connected fuse elements, even though the basic form may be a metal strip with holes punched to produce contracted cross-sections, or beads of another metal of different resistance-temperature characteristics deposited on the main fuse element. These new fuse designs also call for a large number of tests corresponding to the wide range of different operating conditions they have to cater for. The author points out certain inconsistencies in various national regulations on fuse tests and outlines necessary revisions to render them more realistic.—" Investigations on Fuses with Special Reference to Their Desirable Characteristics," D. Wittmann, *A.S.E. Bull.*, Vol. 45, No. 20, pp. 842–844, 2nd October, 1954, in German.

Concentric Alternator Coils

Short circuits, incorrect synchronization and asynchronous operation of alternators may lead to considerable mechanical stressing of the windings, particularly of their end connections. The determination of these stresses must be based on the peak value of the possible short-circuit current in the most unfavourable case (alternator terminal voltage and system voltage in phase opposition). Considering a system of n parallel conductors carrying a.c., each conductor is under a resultant force of n-1 components generally representable as an elliptic field of forces (Lissajous figure). To find the actual maximum value, the d.c. component, if any, has to be added to the modulus of the a.c. field. The mechanical stresses then also depend on the arrangement of the end connections which may be in two or in three planes.

Since it is not possible to base the calculation on the complicated real arrangements, an appropriate equivalent conductor system is used which enables the method of electric images to be applied to the solution of the problem. By this method the problem is reduced to a form which may be solved by geometrical inversion, thus graphically. This procedure can be used only in the case of all the components being in phase; where there are phase differences, the analytical method must be applied. So far, however, the problem has been considered in an idealized form, viz. for linear (infinitely thin) and infinitely long conductors, i.e. for current filaments. It is then shown how to lift these restrictions and pass to the consideration of conductors of finite (circular or rectangular) section and finite length. A numerical example demonstrates the application of the theoretical results to a concrete alternator design.—" Dynamic Stressing of the End Connections of Concentric Alternator Coils," D. Mayer, *E.u.M.*, Vol. 71, No. 20, pp. 473–478, 15th October, 1954; pp. 504–511, 1st November, 1954, in German.

Transmission Tower Foundations

After a comprehensive survey of the wide divergences of the results of various methods of solving the equilibrium problem of overhead line tower foundations, the author concludes that these methods are all based on arbitrary " models " of the actual phenomena not founded on any physical laws or correct evaluation of available test results, but simply on different and mostly unsuccessful attempts to represent certain series of tests in a convenient mathematical form. The definition of certain fundamental parameters such as reaction moment and overturning moment is ambiguous making the reproducibility of the test results doubtful and correct evaluation impossible. This is accentuated by the fact that stress-slope diagrams always show a discontinuity indicating turbulent phenomena preceding the actual overturning.

This discontinuity may be taken as the actual limit of stability, or equilibrium, and a new and simplified method of checking the results of theoretical representations may be based on it. On the other hand, the author introduces this relatively reliable experimental datum into his own theory of the equilibrium of foundations published earlier (1939) and shows that the geometry of the tower footing may be considered by certain shape factors. Since all the factors of the characteristic equations represent algebraic expressions, their determination is possible by nomograms, which facilitates the evaluation of the experimental curves yielding limiting stress and form factors in terms of the shear strain coefficient. The cohesivity or otherwise of the soil are also considered in the determination of the clamping moment.—" Design of Prismatic Embedded Foundations of Overhead Line Towers," K. Kohler, *A.S.E. Bull.*, Vol. 45, No. 18, pp. 735–740, 4th September, 1954, in German.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review.*

Electricity in Churches

A BOOKLET on church heating issued by the Central Council for the Care of Churches was reviewed in our issue of 26th November (p. 842). We have now received from the Church Information Board (Church House, Dean's Yard, Westminster, S.W.1) an illustrated booklet, " The Installation of Electricity in Churches " (price 1s, postage 3d), which deals particularly with electric lighting and the wiring for it.

The text distinguishes five general forms of lighting—direct (including floodlighting), semi-direct, semi-indirect, general diffusing and indirect—and comments on the use of any one or combinations of the methods. Fluorescent lamps are said to be capable of giving satisfactory results but care is necessary in their application. Responsibility for the choice of fittings is placed on the architect.

After setting out the procedure for obtaining faculties for electrical installations there are brief notes on wiring and care of installations.

Part II specifies conditions to be observed by electrical contractors. First there are rules for the avoidance of unsightliness and damage to the fabric and then the necessity for observance of the I.E.E. Regulations, Electricity Board requirements and insurance companies' rules is stressed.

Sections follow on metering and control gear, wiring systems, flexible cords, conductor sizes, switches and switch-sockets and earthing. There are also some brief notes on the wiring of organs and blowing apparatus.

Storage Water-Heaters

A REVISED edition of the fifteen-year-old B.S.843, " Thermal-storage electric water-heaters," has just been published at 4s, by the British Standards Institution, 2, Park Street, London, W.1. The scope of the revised standard has been widened to include water-heaters with either copper or nickel-copper alloy containers. The standard now includes provision for dual-purpose water-heaters of the pressure type, and of 18/20 gal rated water capacity, having two groups of heaters, one towards the top of the container and the other near the bottom, the two groups being independently controlled. It also allows for the construction of non-pressure type water-heaters with concealed fixings.

The standard has been brought into line with the requirements of the Ministry of Health Model Bye-Laws, Series XXI, where these are applicable. Although installation requirements do not fall within the scope of this specification, particular attention is drawn to the necessity of providing pressure water-heaters with an open vent pipe, the diameter of which, in order to avoid excessive heat loss, should not be larger than is required for safety.

Metal Rectifier Problems

Low Voltage High Current Applications in the Chemical Industry

By **D. ASHBY, A.C.G.I., B.Sc.(Eng.), M.I.E.E., A.M.I.Mech.E.***

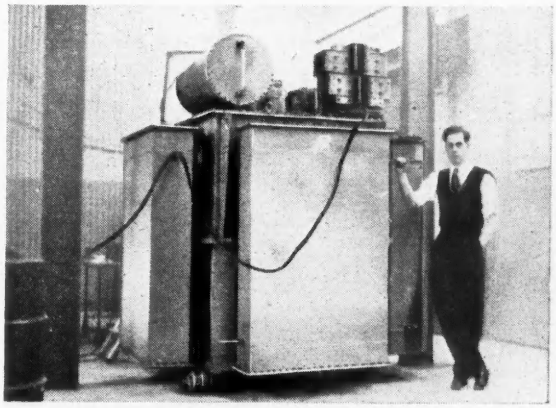
THE chemical industry has presented some interesting problems to electrical engineers, who have been called upon to provide very heavy currents, often at a low voltage, for electrolytic cells. Direct current is essential as the action in the cells dissociates the electrolyte into its constituent parts which appear, usually as a gas, at the anode and cathode, and current values of up to 50,000 A are required. These plants operate continuously, so the electrical plant must be entirely dependable; running costs are a vital feature in the economics of the process, hence efficiency of the power plant, cost of maintenance and extent of idle time for fitting replacement parts are of the highest importance.

For a given production there is the choice of a number of small-capacity electrolytic cells in series, requiring a high voltage, or fewer larger cells in series requiring a substantially higher current at a lower voltage. Large-capacity cells may offer advantages in efficiency and in other ways may be economically more attractive.

The motor-generator and the mercury-arc rectifier have been in the past the only sources of d.c. derived from the available a.c. power supply, for installations of any size. The mercury-arc rectifier, with a steady volt drop of about 15 to 20 V in the bulb, is less efficient at the lower voltages, but the efficiency of the rotating machine and the cost of brush replacements are adversely affected as heavier currents are required at lower voltages.

The selenium rectifier has proved a highly reliable means of providing heavy currents for electroplating and other electro-deposition processes operating at voltages of 16 V or less, where the advantages of an oil-immersed static plant, requiring no attention and maintenance and with an overall efficiency of 80 per cent or higher, has established the rectifier as the accepted power unit in this field. The technical development of copper-oxide and later selenium rectifiers for heavy current supplies has been led by Britain, and rectifier equipments totalling at least 6,000,000 A annually have been produced, in this country alone, for many years.

* Mr. Ashby is with the Westinghouse Brake & Signal Co., Ltd.



Water cooled oil immersed 33 V 6,000 A rectifier; floor space 7ft by 6ft

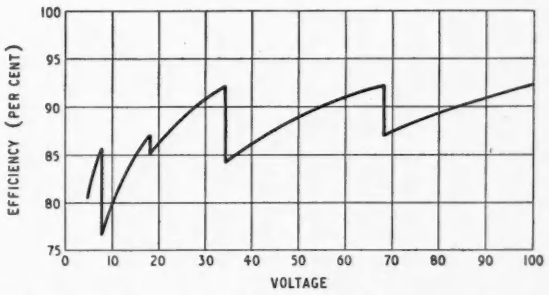


Fig. 1.—Efficiency of modern heavy current selenium rectifiers for varying d.c. voltages; losses in transformers, regulator and bus-bars not included

While higher voltage selenium rectifiers have been widely used for anodic protection of aluminium, requiring 50 to 60 V, their use in electrolytic work has hitherto not been extensive. Efficiency, bulk and price have not proved sufficiently attractive to justify their use, though for outputs of up to 50 kW they are applied to every branch of the electrical industry. Recent improvements in performance have lifted the level of output and have opened up a wide field of use in which the economic boundary is well over 100 V.

The designer of a selenium rectifier equipment can, by choice of circuit, type of rectifier element and number of elements in series, achieve an optimum efficiency at many different voltages, unlike the mercury-arc rectifier in which the efficiency increases with increasing d.c. voltage, and the motor generator in which the power output decides the motor size and efficiency, while the d.c. voltage value influences the efficiency of the generator. As will be seen from Fig. 1, the efficiency of the modern selenium rectifier is an optimum value at voltages of 33, 67, 100 and 133. By switching groups of rectifiers in series, high efficiencies over a wide range of voltage can be obtained.

The Glamorgan Alkali & Acid Company has installed in its factory at Rhydyfelin, Glamorgan, a number of electrolytic cells, made by Oronzio de Nora, of Milan, for the production of hydrochloric acid, which is used by the parent company, the Treforest Chemical Company, in the extraction and purification of gelatine from animal bones. Concentrated brine is pumped into the cells in which chlorine is evolved at the graphite anodes, and the mercury cathode allows the sodium to combine as an amalgam; by subsequent treatment with water the sodium is released as caustic soda and hydrogen is evolved, which is later burnt with chlorine; the resulting hydrogen chloride is dissolved in water to produce hydrochloric acid.

It was decided to use a selenium rectifier for the power supply to the 15 cells which in series required 23,000 A

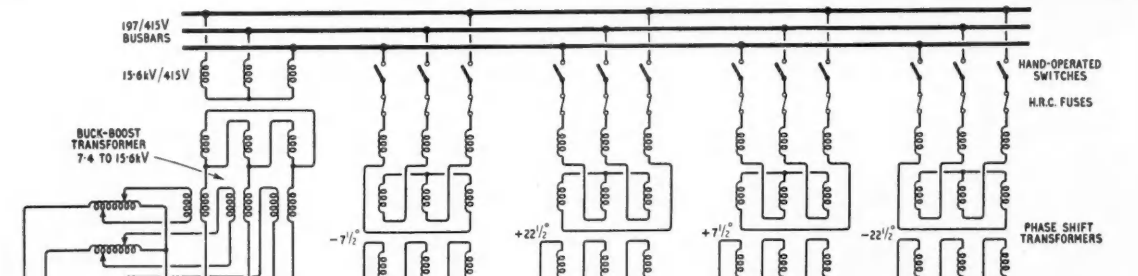


Fig. 2.—Basic circuit of 24-phase rectifier installation

at 67 V. The Westinghouse Brake & Signal Co., Ltd., obtained the contract, and the installation work was carried out by the Tucker Electrical Co., who supplied the a.c. switchboard.

This installation is probably the largest selenium rectifier equipment in existence. When the plant is first switched on, a small current is desirable to check that all joints are gas-tight, and this current is gradually increased as the system is purged before pure chlorine can be collected. The back e.m.f. of the cells is about 2·6, the voltage rising to 4·3 on load. The rectifier must be adjustable over a range of 40 V at almost zero current, to 67 V at 23,000 A. Smooth regulation under load is achieved by employing a " Breco " voltage regulator, made by the Brentford Transformer Co., Ltd. The regulator is connected in the 11 kV feed to the plant and consists of two double-wound transformers, one stepping down to provide current to the regulator, which feeds the other transformer, the secondary of which is in the main circuit. The regulator has two sets of moving contacts, each of which can traverse the length of the winding to provide a buck or boost to the second transformer. The 11 kV power input is thus subjected to a buck or boost of 4·6 kV. A 15,600/415 V transformer follows the regulator, the secondary supplying the l.v. panel which distributes power to the transformers and rectifiers. There are three groups each of four transformers, the delta secondary windings of which are connected to three-phase bridge-connected rectifiers; by disposition of the secondary windings at 7½ deg intervals the combined rectifier produces a 24-phase output. The basic circuit for a 24-phase rectifier installation is shown in Fig. 2.

A polyphase rectifier circuit reduces the ripple content in the d.c. circuit. This ripple is dissipated as heat without contributing towards the electrochemical action. The three-phase bridge circuit gives a 6-phase d.c. output with an r.m.s. ripple content of about 4 to 5 per cent, depending on the balance of the three input voltages and the balance of impedance in the three lines. A 12-phase d.c. output reduces the ripple content to about 1 per cent. The ripple power is, however, less than this, and little is to be gained by increasing the phases. A 12-phase d.c. rectifier would have large amounts of 11th and 13th harmonics of line current in its a.c. input and these harmonics can cause considerable distortions to a power system. A 24-phase circuit was employed in which the 23rd harmonic of input current is the lowest and this is present only in very small amounts. The resultant high power factor of about 0·99 is another advantage compared with some forms of power convertor.

The current is controlled by push buttons which cause the transformation ratio of the regulator to vary, thereby raising or lowering the d.c. current, the value of which is indicated by an ammeter at the push-button station. This ammeter, fed from a current transformer in the input to the whole equipment, allows the total output current to be metered very easily. It has a further advantage that a number of remote indicating ammeters can be supplied through quite small leads without any serious effect on accuracy.

It was necessary to have the plant operating within seven months of placing the order, so stock components were used wherever possible. Naturally cooled oil-immersed rectifier tanks as used for electroplating have all the advantages of simplicity, though the poor heat transfer between the tank walls and the surrounding air makes for a bulky design. Each of the 80 tanks contains a 33 V 575 A three-phase bridge-connected " Westalite " selenium rectifier, which at this rating has an efficiency of about 95 per cent. There was no lack of space in this instance, but space is often very costly and some form of accelerated heat transfer may be imperative. Water cooling of the oil by means of some form of heat exchanger is an attractive alternative, provided adequate precautions are taken to reduce the risk of any leakage in the heat exchanger or, should any occur, to ensure that oil leaks to water rather than water to oil.

Anglo-French Television Link

FOLLOWING the successful series of European television programme exchanges during 1954, the B.B.C. has placed an order with the Post Office for a permanent two-way television link between London and the Continent. This will replace some of the temporary equipment that has been used for the experimental programme exchanges.

The first section of the permanent link, which should be ready by the end of this year, will consist of coaxial cables between London and St. Margaret's Bay, Kent. The next section will consist of a two-way radio link across the English Channel to be operated in conjunction with the French P.T.T. This will take three years to complete, but in the meantime the permanent coaxial cables will be temporarily extended from St. Margaret's Bay to Swingate near Dover, where the B.B.C. and Radiodiffusion et Télévision Française will provide and operate a temporary two-way cross-Channel radio link between Swingate and Cassel in Northern France.

ELECTRICAL PROGRESS—1954

The British Thomson-Houston Co., Ltd.

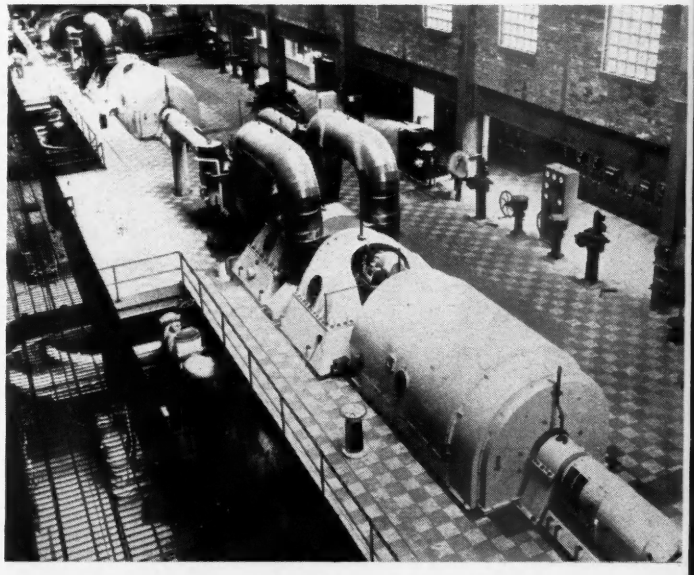
DURING the past year the factories of the British Thomson-Houston Co., Ltd., have continued to operate at full capacity to meet the demands from home and overseas customers for electrical plant of every description. A ten-year expansion plan for the production of turbo-alternators and associated equipment, which will enable the output of plant to be trebled and the repair services to be improved, was started during the year.

Among orders received was one for the sixth twin-cylinder 30 MW turbo-alternator set for the Goldington power station of the B.E.A., and one for the third and fourth 30 MW single-cylinder sets to be installed at the Wallerawang power station of the Electricity Commission of New South Wales. Machines commissioned at home include a 75 MW set for Barking "C" and two further 30 MW sets which complete the six machines to be installed in the Walsall power station. The fourth 30 MW set at Westwood power station, Wigan, also went into service.

Overseas, the first of two 30 MW sets was put into service in the Umgeni power station in Natal, while in Australia the first of four 30 MW sets has been commissioned in the Tallawarra power station of the Electricity Supply Commission of New South Wales. An outstanding event was the commissioning of the first of two 2,500 kW gas turbines in Nairobi. It is believed that this is the first gas turbine to be installed in the African Continent, and the first gas turbine running on residual oil fuel to be put into operation abroad by a British manufacturer.

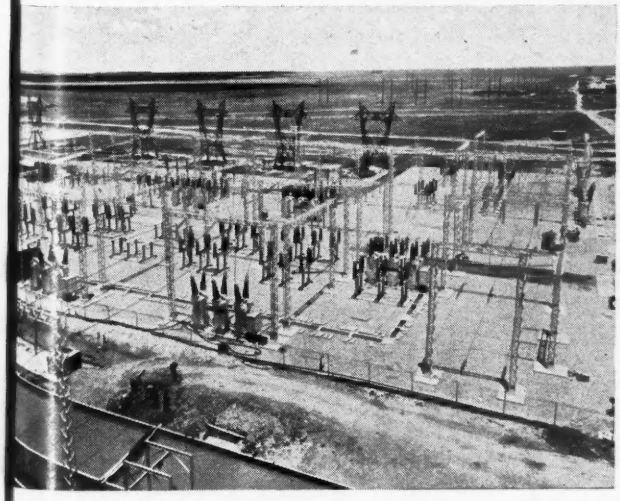
During the year two 90 lb/sq in 20 cu ft/min synchronous motor driven compressors were delivered to New Consolidated Gold Fields, South Africa. Two synchronous motor driven two-stage air blowers of 19,500 cu ft/min and 12,300 cu ft/min capacity were also delivered to Rolls Royce, Derby, for installation in a new turbine test rig at their Sinfin plant. Early in 1954 two gas boosters for the North Thames Gas Board, Fulham Gas Works, were put into commission. One of these machines, which is turbine driven, deals with 2,000,000 cu ft/hr of gas against 176in water gauge differential. The other machine, which is motor driven, deals with 600,000 cu ft of gas per hour and is arranged for open air operation.

Among the marine propulsion gearboxes completed during the year were the geared twin-diesel drives for M.V. *Essex* and M.V. *Northumberland*, the former vessel now being at sea. Six 1,200 kW sets have been installed in the S.S. *Arcadia* and S.S. *Iberia*, both owned by the P. & O. Steam Navigation Co., each vessel being equipped with three 1,200 kW turbo-generators. The 2,500 kW set for the British Sugar Corporation, Brigg, is now in operation, and a further 2,500 kW set is being built for the new B.T.H. factory at Larne in Northern Ireland.



Right: Turbine room in the 120 MW Westwood generating station of the B.E.A., which houses four B.T.H. 30 MW sets

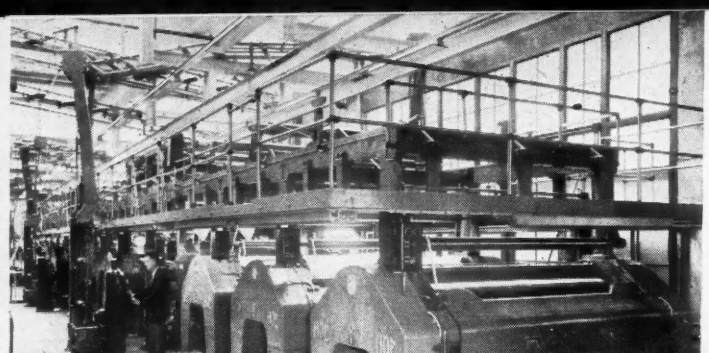
Below: B.T.H. 132 kV, 3,500 kVA oil circuit breakers at the Taaibos station, South Africa



The most important event during the year in the hydro-electric field was the opening, by the Queen, of the Owen Falls station in Uganda. Orders for this station cover eight 15 MW vertical alternators, two of which are now in commission. Two more are being erected and the major part of the work on Nos. 5 & 6 is now being completed.

During the summer, however, two large alternators of very different construction were completely assembled and tested in the works. The larger of these was a 40 MW, 136·4 r.p.m., vertical machine—one of four ordered for Roxburgh power station in the South Island of New Zealand. When complete, this station will house eight units and will then be the largest in the Southern Hemisphere.

The year brought to a successful conclusion the development of an automatic circuit recloser for use on rural lines up to and including 11 kV. It is a single-pole dead tank device, which is normally held closed under the action of incorporated springs. It opens automatically upon the passage of fault current by means of a series-connected



Daily Mirror Newspapers, Ltd., printing presses with B.T.H. drive and electronic control

solenoid coil, the minimum current to operate it being twice the current rating of the coil.

For the supergrid, work is well advanced on a two-switch 275 kV, 7,500 MVA switching station at West Melton. Erection is also proceeding at a number of 132 kV, 3,500 MVA switching stations, including a 14-switch station at Marchwood, a 20-switch station at Castle Donington, and further extensions at West Melton, East Yelland, Bonnybridge, Currie, and Skelton Grange substations.

Development work has continued on circuit breakers for service at 300 kV and above, and ratings up to 25,000 MVA; as part of this programme successful tests have been carried out at the Switchgear Testing Company's station for a rating of 15,000 MVA at 230 kV to Canadian standards.

A further five type OW409, 132 kV, 3,500 MVA oil circuit breakers for the new Taaibos station of the Electricity Supply Commission of South Africa were ordered during the year. Eleven of these breakers were despatched during 1953 and have now been installed.

Development work is now well advanced on new 33 kV metalclad gear incorporating vertical isolation. Orders continue to be received for the established metalclad designs and include two switchboards, totalling fifteen equipments of 22 kV, 500/750 MVA, double-bus, Class MF 36 switchgear for the B.E.A. London Division, Woolwich power station ; a seven-panel, 22 kV, Class MF 75 switchboard for B.I.C.C., for the Bombay Suburban E.S.C. ; and extensions for the B.E.A. at Bolton and Shoreditch.

During the year the second 120 MVA, 132/275 kV transformer was installed at Staythorpe, and the first similar unit for West Melton is nearing completion. Other transformers for the B.E.A. and Area Boards completed include the first and second 72 MVA, 11·8/141·6 kV, oil-filled water-cooled units for Meaford " B," and the fifth and sixth 75 MVA, 14/132 kV, oil-filled water-cooled units for Staythorpe " A " ; also the first and second 60 MVA, 132/33 kV transformers for King's Lynn, and a second similar unit for Llantarnam.

Overseas transformer installations completed during the year included one 10 MVA, 31·5/6·6 kV transformer for Lisbon Tramways ; two 42 MVA, 11/132 kV, three-phase transformers for the Hirakud Dam project, India ; the seventeenth 15 MVA, 220 kV, single-phase transformer for the State Electricity Commission of Victoria ; seven 16·7 MVA, 220 kV, single-phase auto-transformers at the Haywards substation of the New Zealand Hydro-Electric Department ; three 15 MVA, 33/12 kV, three-phase transformers for Capetown ; two 15 MVA, 33/6·6 kV, three-phase transformers for Durban ; and one 12·5 MVA, 11/110 kV, unit for the Mettur power station, Madras.

Several notable pumpless steel tank rectifier installations have been commissioned. In addition to the four 1,200 kW, 630 V rectifier units supplied to the London Transport Executive for Whitechapel substation, a further five rectifiers are now in course of manufacture for Earls Court substation. The transformers for these units are of the totally enclosed, fan-cooled dry type, but to reduce the maximum weight to be handled, each transformer is divided into two 600 kW, six-phase units operating as a 12-phase combination.

The year has been a record one from the point of view of the number of ships fitted with B.T.H. electrical machinery which have been commissioned. In all, five vessels, two 8,300 s.h.p. a.c. turbo-electric, and three 7,000 s.h.p. d.c. diesel-electric, have been completed, and a further fourteen fitted with B.T.H. auxiliary generating plant have also entered service. The electric propulsion machinery in each ship consists of four 1,392 kW, 400 V, 360 r.p.m. main generators and a 7,000 s.h.p., 150 r.p.m., double-unit propeller motor, together with associated auxiliaries and the main propulsion control gear.

Diesel-electrics have continued to form a considerable part of traction business. A further sixteen sets of electrical equipment for the 155 h.p. Ruston B.T.H. works shunter have been ordered. New orders from the Yorkshire Engine Co. for power equipments have included two 200 h.p., six 275 h.p. and two 400 h.p. sets and a number of industrial works are now using the Y.E.C. heavy-duty shunters. Production of fifteen sets of power equipment for British Railways shunters is well advanced.

The past year saw an increase in the National Coal Board's mechanization programme, necessitating expansion of electrical distribution systems both on the surface and underground, coupled with the continuance of the formidable winder projects already envisaged. All types of electrical equipment for the mining industry have been delivered and installed.

The most interesting rolling mill drive to go into operation during the year has been that for the new " plug " mill at Stewarts & Lloyds, Ltd., Corby. This mill produces seamless steel tubes. The main drives comprise a 1,500 h.p., 500 r.p.m., 11 kV slipring induction motor driving the piercer, a 1,000 h.p., 300 r.p.m., 11 kV induction motor driving the plug mill, and two 350 h.p., 500 r.p.m., 3·3 kV motors driving reelers. Also put into operation was the drive for an extension to the bar mill for Steel, Peech & Tozer, Ltd., Sheffield, comprising two 300 h.p., 300/600 r.p.m., d.c. motors supplied from two pumpless steel tank mercury arc rectifiers.

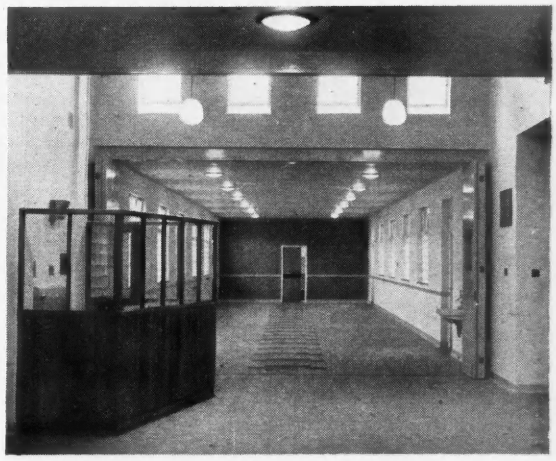
The increasing importance of electronics in newspaper offices is demonstrated in the new production plant now being brought into use in stages by the *Daily Mirror* and its companion papers. There are three lines of printing presses, two of which are driven by forty 50 h.p. d.c. motors under " Emotrol " control. Maximum press cylinder speed is 25,000 r.p.h., which, with plates duplicated, prints at the rate of 50,000 copies an hour from each of the two deliveries. Each press line has four double folders so that the theoretical output of the whole installation is at the rate of 1,200,000 copies per hour of a 24-page paper. In addition to the motors and " Emotrol " equipments B.T.H. has supplied lectern-type desks, thrustors for the hydraulic brakes, and motor section control cubicles.

Continuous progress has been made in lamps and lighting during the year. Some of the more important lamp advances include a new range of fluorescent lamps introduced in March, a 400 W addition to the range of MBF/U colour-corrected mercury discharge lamps, a new 1 kW horizontally-operated mercury lamp and a 10 kW projector lamp for use in film studios, which is claimed to be the largest tungsten filament lamp made in the country.

Hospital Installation

THE first of three villas for the accommodation of the lowest grade of mentally deficient patients has recently been opened by the East Anglian Regional Hospital Board at Little Plumstead Hall, near Norwich. Comprising a day room, dormitory, toilet section, kitchen and extensive verandahs, the building incorporates many novel features designed to provide better nursing facilities and greater comfort for the patients, with adequate observation and the prevention of infections or injuries.

As a result of a considerable amount of investigation and research involving consultation with medical and nursing staffs, psychiatrists, etc., special attention has been paid to all details including colour schemes, and heating, lighting and radio broadcasting facilities, all of which are found to have a marked effect on the well-being of the patients. In the day room the ceiling is ivory, the side walls pale green and the end wall pale rose with the doors cream and grey. The dormitory has a mist blue ceiling, walls of daffodil and romany red, door frames in off white, while the floor is fawn with red or black centre designs. The whole of the electrical installation (except in the basement) has been concealed in the walls and ceilings, etc.



One half of the new dormitory at Little Plumstead Hall, showing nurses' observation and control booth on the left

High Level of Illumination

In view of the favourable reaction of the patients to bright lights the illumination throughout the villa has been intentionally kept at a high level with facilities for sectionalized control. The lighting fittings (of Falk Stadelmann and Hume, Atkins & Co., Ltd., manufacture) are of the acorn pendant pattern in the day room and totally enclosed type in the dormitory and toilet rooms. The fittings in the dormitory have been recessed into the ceiling and are specially designed to avoid damage by patients.

The arrangements in the dormitory are particularly interesting. This room is arranged in two identical halves each comprising a ward of twenty-five beds with a separate single room for special cases. In a central position between these two sections is a glass partitioned booth from which the nurses have complete control not only of the patients but also of the lighting as well. There are thirteen lighting fittings in each half-ward and the switching arrangements make it possible to secure almost any desired illumination, bright or dim. A buzzer in the observation booth gives warning should the temperature of the heating system rise unduly.

The building is warmed by means of hot water circulating in coils embedded in the floors. The water is circulated by Pulsometer pumps driven by a ½ h.p. Crompton Parkinson motor. The hot water is provided by means of a Britannia "Ideal" boiler fitted with an "Iron Fireman" automatic coal burner, a similar unit being provided for the domestic hot water system. The heating system which is time switch controlled by means of Sangamo instruments is also regulated thermostatically by means of "Satchwell" thermostats and mixing valves in accordance with temperatures outside the building. The domestic hot water is pumped round the building from two calorifiers by means of a pair of Pulsometer pumps driven by Crompton Parkinson ½ h.p. motors.

Adjacent to the boiler house in the basement is the electrical intake room accommodating a 440 V three-phase and neutral switchboard made up of Kartret switch fuses. The incoming cable and sub-mains are paper insulated lead covered. The electrical distribution is arranged by means of three combined lighting and power sub-distribution boards recessed into the walls. A kWh meter enables a check to be kept on the individual electrical consumption of the villa. To facilitate installation and maintenance of the electrical and heating systems crawlways are provided under the building, pilot lights showing when the lighting in them is switched on.

The kitchen equipment includes an Euk hotcupboard and a Burco washboiler used for preparing boiling water for tea preparation. "Genalex" clocks are installed throughout the building, which is linked with the existing Reliance intercommunication telephone system. All the sub-switches and sockets are of Wandsworth Electrical Manufacturing Co.'s production and are provided with locked plates and concealed fixing screws designed to prevent interference by the patients. Other items of electrical interest are electric wall panel heating in the medical room and an extract fan system in the toilet room.

Mr. Guy Aldis, A.R.I.B.A., architect of the East Anglian Regional Hospital Board, was responsible for the scheme, Messrs. P. H. Allins & Sons, of Cambridge, carrying out the electrical installation and G. N. Haden & Sons, Ltd., the heating and hot water installation. We are grateful to Dr. J. V. Morris, medical superintendent of Little Plumstead Hall, for giving us permission to inspect the installation, and to Mr. E. W. Martin, chief engineer, for his assistance in preparing this article.

I.E.S. Scottish Meeting

THE Scottish and Northern Centres of the Illuminating Engineering Society are holding a combined meeting on 6th and 7th May, at Peebles Hotel Hydro. Dinner on the first day will be followed by a presidential reception and the main dance. The following morning, after a presidential welcome, a lecture, illustrated with pictures and sound, will be given by Monsieur J. J. Chappot, of Paris, on light and sound spectacles in France. Luncheon will be followed by a lecture by Mr. J. M. Waldram who will discuss trends in lighting practice. Afternoon tea will be taken with the president's lady at which there will be a mannequin parade. The meeting will conclude with a dinner and dancing. Further information can be obtained from Mr. R. J. Fothergill, Northgate House, St. Mary's Place, Newcastle-on-Tyne, 1.

New Books

Electronics. By Thomas B. Brown. Pp. 545; figs. and index. Price 60s. **Electronics,** by G. F. Corcoran and H. W. Price. Pp. 459; figs. and index. Price 56s. Both published by Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2.

The issue by the same publishers of two books with the same title but widely different subject matter draws attention to the imprecision with which the word electronics is currently used. Professor Brown, correctly in our opinion, defines electronic phenomena as those in which conduction takes place through the motion of free charged particles in free space and describes the generation and control of such particles, devices using them and the basic circuits employing such devices. Crystal rectifiers and transistors are included, so it would seem unnecessary to include the reference to free space.

Professor Corcoran and Mr. Price essay no definition of their subject, saying that emphasis has been placed on circuitry but the basic physical principles are included at a level comprehensible to junior (1st year?) students. They too, include a chapter on transistors. With this exception, there is very little material which cannot be found in many good books on radio communications. However, it is not the function of a textbook to be original and their treatment is very good. Here, we can only mention some of the best features, such as the emphasis put on the nodal technique for network analysis, the careful treatment of harmonic distortion in valve amplifiers and the extensive (29 page) introduction to feedback amplifiers and the Nyquist stability criterion. The 56 page account of transistors succeeds in laying the foundation for the understanding of transistor circuitry. A bad feature of Corcoran and Price is the almost complete lack of references either to original work or to more specialized textbooks.

Professor Brown is very much less mathematical, but gives a very clear physical picture of the operation of most thermionic devices including modern microwave generators such as the klystron and the magnetron. A very likeable feature of this book is the inclusion of descriptions of laboratory experiments with lists of apparatus and comments on the nature of the observations to be made, their recording and checking. Electronics is, after all, an experimental science (very much so!) and authors need not disguise the fact. Professor Brown gives a simple but correct account of most thermionic devices, including effects not usually discussed in elementary books.

Both books are excellently printed and are a pleasure to read. Large numbers of problems are given at the end of each chapter. Both are good, but I think Professor Brown has a better idea of what students need and of the level required in admittedly introductory books. The reader will have to depend on his individual taste to determine whether he chooses one or the other or prefers one of the older favourites.—A.H.B.

Telecommunications. By A. T. Starr, M.A., Ph.D., M.I.E.E. Pp. 454; figs. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 35s.

There has been a need for a long time for a book on telecommunications suitable for students studying this subject for an engineering degree.

Dr. Starr has done much towards supplying this need with a well-written and up-to-date work which contains as far as one can see all the necessary basic information, in the comparatively short space of about 450 pages. It is quite an achievement to have managed to deal with such a wide range of material as telegraph, telephone and radio communication systems, acoustics, transmission networks and lines, radio, television, wave propagation, micro-wave technique, etc., so concisely.

The principles of each section are clearly stated and their application to theoretical problems is illustrated from time to time by worked examples from past examination papers. A good point is that the circuit diagrams often have component values marked in. This marking of values is known to be very helpful to students in their attempts to visualize circuit action.

Appendices deal with a variety of useful supplementary information such as common mathematical formulæ. Fourier analysis and its application, use of the Laplace transform, the Maxwell field equations and wave-guide theory.

Throughout, the treatment is terse, and a student may find it desirable to supplement his reading of this book from fuller accounts given elsewhere. Certain sections of the book appear in almost identical form in other works by the same author.

Apart from minor criticisms such as occasional looseness of phrasing, and the use of technical jargon at times, this textbook can be very confidently recommended.—L.C.W.

A Textbook of Illumination Engineering (Intermediate Grade). By J. W. T. Walsh, O.B.E., M.A., D.Sc. Second edition. Pp. 202; figs. 137. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 28s.

Few are better equipped than Dr. Walsh for the task of preparing and re-editing a book of this nature. As a past president of the Illuminating Engineering Society, he has seen the growth of this most important branch of electrical engineering.

He has a style which is both easy and yet instructive, and seems to take as his foundation stone the text, "If your eye tells you that there is something wrong . . . diagnose the trouble and . . . suggest a remedy . . . If an installation pleases you, try to analyse its good points. First, last, and at all times, *use your eyes.*"

Various chapters cover: the nature of light, the eye, measurements, daylight, light by combustion, light by electricity, control of distribution, design with examples, costing, and colour.

The new edition has improved certain sections for the City and Guilds examinations, and brought the terminology into line with the relevant British Standards. The chapter on colour includes the trichromatic calorimeter (Donaldson in detail), reference stimuli (C.I.E. especially), spectra and chromaticity diagrams and the spectrophotometer: this is added especially for those taking illumination as their main subject for the I.E.E. examination finals.

The chapters on design of schemes, etc., give illustrative examples of details in industrial tasks. Nomograms for illumination, etc., types of reflectors, utility factors, maintenance factors, etc., all help to make these chapters most instructive. To an electrical engineer, the sections on gas lighting give an unusual view of a competitor, and the knowledge of the difficulties involved (both in distribution and mantle design) may come as a shock.—E.H.S.

BOOKS RECEIVED

Linear Transient Analysis. Vol. I. By Ernst Weber. Pp. 313; figs. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 52s in U.K.

Automatic Protection of A.C. Circuits. By G. W. Stubbings. Fourth edition revised by C. M. Dobson. Pp. 355; figs. 213. Chapman & Hall, Ltd. Price 50s.

Material Handling in Works Stores. By. L. J. Hoefkens. Second edition. Pp. 196; figs. 103. Published for *Mechanical Handling* by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 18s.

Active Networks. By V. C. Rideout. Pp. 485; figs. Constable & Co., Ltd., 10-12, Orange Street, London, W.C.2. Price 42s.

Control System Dynamics. By Walter R. Evans. Pp. 282; figs. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4. Price 50s in U.K.

Miniature Circuit Breakers

Technical and Economic Aspects

A CRITICAL survey of the design, performance and economic application of miniature circuit breakers was given in a paper presented yesterday before the Institution of Electrical Engineers' Utilization Section by Messrs. H. W. Wolff (M.C.R. Co. (Manchester) and formerly of Dorman & Smith) and T. G. F. Atherton (Dorman & Smith).

The two distinct duties of such circuit breakers, the authors stated, were, to make and break rated current up to 15,000 times if used as 5 A tumbler switches and to give protection against short circuits, the prospective currents seldom exceeding 3 to 5 kA or 1 kA in sub-circuits. The mechanism was of the " trip-free " type usually with a rolling or wiping action across butt contacts to minimize voltage drop. Typical dimensions varied from $3\frac{3}{8}$ to 5in in length, from 1 to $2\frac{1}{4}$in in width and from 3 to $4\frac{3}{4}$in in maximum projection, but could be reduced appreciably by the adoption of moulded cases.

Arc chutes, e.g. of asbestos compounds, affected breaking capacity on short circuit more than any single factor. Blow outs, self-excited for a.c. duty, were often used to draw the arc rapidly away from the small contact gap. Arcing contacts and further auxiliary contacts had sometimes been used to simulate the operation of larger breakers.

Time Delay Devices

Instantaneous tripping (meaning in practice a time delay of about 10 millisec) invariably worked on the electro-magnetic principle and was required in all cases for protection against heavy faults. Time-delay devices of the thermal bimetal strip (directly or indirectly heated) types or of the electro-magnetic type with dashpot were used to prevent undesired tripping on starting and switching surges and short overloads ; e.g. the current on switching on a filament lamp reached 10 to 12 times the normal for 4 millisec.

Thermal time delays were cheap, compact and easily calibrated and adjusted, but could not operate instantaneously on short circuit ; a separate electro-magnetic trip for that purpose was thus needed. Combinations of the two functions had been devised, however, in which a bimetallic strip acted as a conductor during short circuit, being attracted by a magnetic block.

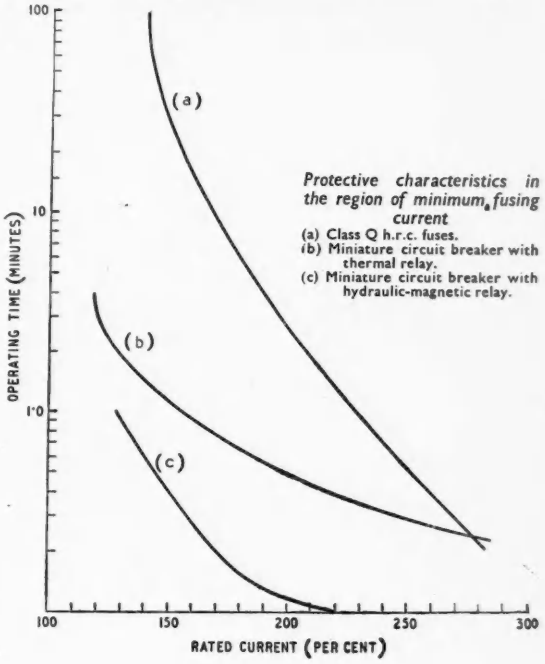
Thermal trips had a long resetting time (which might exceed 2 min), whereas dashpots for the electro-magnetic type could be reset immediately by means of a non-return valve, which would permit the inching of motors against heavy loads. Operation of the dashpot was also less dependent on temperature, provided the oil had a flat viscosity-temperature characteristic such as that of silicone fluids, though ambient-temperature effects were compensated for in some thermal designs. Electro-magnetically operated dashpots could be built up as sealed units, free from external interference, and particulars of one design were given.

Rupturing capacity had two values, the actual and the useful. The latter was unlikely to exceed one-half to one-quarter of the prospective short-circuit current, permitting 50 to 100 fault clearances without ill effects. Commendatory reference was made to the Australian specification, which required that throughout the breaking-capacity test loose dry cotton waste surrounding the operating handle and openings in the enclosing case should not ignite. This criterion was more severe than the blowing of an earth fuse connected to a metal case. The cotton waste usually ignited at the actual rupturing capacity, whereas the earth fuse might remain intact.

The maximum current effectively broken varied inversely as the square of the voltage, so the apparent power varied inversely as the voltage under the same conditions. For existing designs the maximum a.c. rupturing capacity was about 1 MVA per pole per phase down to about 0·5 power factor, below which a miniature circuit breaker was unlikely to retain its full efficiency after three to six operations. Speed of clearing such high currents was limited by the definite minimum time of the mechanism and overload device. Consequently the breaking capacity of a given design was independent of current rating, provided the overload coil or bimetal strip for the lower ratings could withstand the effects of a fault surge.

For the lower current ratings the prospective current would be limited by the impedance of the overload device. Thus for the 5 and 2·5 A ratings of one design incorporating an electro-magnetic time delay, the prospective current at 250 V (a.c. or d.c.) would be limited to 2,500 and 750 A respectively. With d.c. a breaking capacity not exceeding one-quarter of the a.c. value was to be expected, and the rating was commonly halved.

Making capacity would probably be somewhat lower than maximum breaking capacity and could be taken as about equal to useful breaking capacity. The difference was due mainly to absence when making circuit of contact pressure and of contact wipe. The consequent risk of welding could



Protective characteristics in the region of minimum fusing current
(a) Class Q h.r.c. fuses.
(b) Miniature circuit breaker with thermal relay.
(c) Miniature circuit breaker with hydraulic-magnetic relay.

be overcome by using a carbon-tipped arcing contact, but this would result in a fiercer arc. Copper-tungsten or silver-tungsten contacts had excellent erosion-resisting and anti-welding properties, but their lower electrical conductivity reduced their maximum current rating when used as single main contacts.

Operational features of miniature circuit breakers and fuses were compared to account for the considerable post-war increase in the use of the former in distribution schemes and in industrial works and ships, largely owing to lower maintenance cost and avoidance of delays that adversely affected production. Their employment for domestic installations was limited by the cost of present designs.

Rise in Electricity Output

Accelerated Rate in 1954

LAST year the British Electricity Authority and the North of Scotland Hydro-Electric Board generated 72,896 million kWh. This was 7,384 million kWh more than in 1953, an increase which exceeded that in any previous year while the rate of expansion (11·3 per cent) was the highest since 1950 (see Table 1).

In February, when last winter's maximum demand was recorded during a "cold snap" at the beginning of the month, output rose by 13·9 per cent. This rate of expansion, however, was surpassed twice during the summer, in May (15·2 per cent) and August (14·5 per cent), the cool, sunless weather inducing an abnormal heating demand. There was again a sharp increase in November (14·6 per cent) and the rate remained above the average in December (12·6 per cent).

TABLE 1.—GROWTH OF ELECTRICITY SUPPLY SINCE VESTING DAY

Year	Electricity generated Million kWh	% inc.	Installed capacity at 31st Dec., MW	Net increase MW
1948	46,535	9·1	13,226	497
1949	49,115	5·5	13,913	687
1950	54,959	12·0	15,075	1,162
1951	59,971	9·1	16,328	1,253
1952	61,989	4·0	17,740	1,412
1953	65,512	5·7	19,169	1,429
1954	72,896	11·3	20,567	1,398

Of the total amount of electricity generated last year, 1,759 million kWh (2·4 per cent) was of hydro-electric origin; compared with 1953 this represented an increase of 37·1 per cent (see Table 2). In thermal stations fuel consumption included 39,644,000 tons of coal and coke and 174,400 tons of fuel oil, the latter figure being 78,400 tons more than in 1953.

At the end of the year the installed plant capacity in the B.E.A.'s generating stations was 19,972 MW and in those of the North of Scotland Board 595 MW, a total of 20,567 MW. After allowing for plant taken out of commission, there was a net increase in installed capacity during the year of 1,398 MW (7·3 per cent).

New plant actually put in by the B.E.A. aggregated 1,431 MW of which no less than 550 MW was commissioned in December. It included 60 MW Parsons sets at Keadby, Stella South and Skelton Grange and a 30 MW set at Hackney "B"; a 75 MW B.T.H. set at Barking "C" and one of 30 MW at Walsall; a 60 MW English Electric set at Drakelow "A" with others of 45 and 40 MW at Thornhill and Blackburn respectively; and 60 and 30 MW Metropolitan-Vickers sets at Carmarthen Bay and Roosecote.

Boiler plant installed during the month comprised the following units, in k lb/hr: 405 at Barking "C," 425 at Battersea "B," two of 360 at Uskmouth, 240 at Staythorpe "A" and two of 240 at Carmarthen Bay (all Babcock & Wilcox); 300 at Hackney "B," 360 at Chadderton and 150 at Blackburn (Simon Carves); 320 at Brunswick Wharf and 550 at Stella South (Clarke Chapman); 200 at Thornhill (Mitchell); 550 at Keadby (Stirling); 300 at Roosecote (Yarrow); and 550 at Skelton Grange "A" (International Combustion).

TABLE 2.—ELECTRICITY GENERATED AND CAPACITY OF PLANT INSTALLED*

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total†		
British Electricity Authority ...	3,811	97	23·0	7,020	85	7,114	6,694	19,972
N. of Scotland H.E.B.	16	1	1·5	26	208	240	239	595
Total for December, 1954 ...	3,827	98	24·5	7,046	293	7,354	6,933	20,567
Corres. total for December, 1953	3,476	87	12·5	6,339	179	6,533	6,152	19,169
Increase or decrease, per cent ...	+10·1	+12·6	+96·0	+11·2	+63·7	+12·6	+12·7	+7·3
Total for 1954	38,539	1,105	174·4	70,993	1,759	72,896	68,565	
Total for 1953	35,536	907	96·0	64,068	1,283	65,512	61,631	
Increase or decrease, per cent ...	+8·5	+21·8	+81·7	+10·8	+37·1	+11·3	+11·3	

* Comprising all generating stations controlled by the British Electricity Authority and the North of Scotland Hydro-Electric Board.

† Including 10 million kWh generated by oil engines and 5 million kWh by waste heat plants in December, 1954.

Fuel Economy

AS part of its policy of disseminating knowledge and information on all points concerned with efficient fuel utilization the Federation of British Industries has just published, at 5s, the thirty-third volume of the "Fuel Economy Review." As the introduction points out, it is a disturbing feature of our present economy that it has already been found necessary to import four million tons of coal this winter. With an increasing industrial production the demand for fuel is still rising and the chances of any spectacular improvements in coal production are remote. On the other hand the results obtainable from the more efficient use of fuel in all its forms can be immediate and spectacular.

The rest of the sixty pages of this publication contain eight articles, most of them illustrated, dealing with many of the different economic and technical aspects of this vital subject. There is a description of the origin and evolution of coal and of the methods used by the N.C.B. for determining coal analysis and for control of quality. A guide to the selection of the most economic grade of coal for any particular purpose is followed by a survey of the economics of electrical power generation from process steam demands. Other articles deal with the manner in which the problems of winning coal now and in the future are affected by present and potential physical capacity, heat treatment and processing, and heat recovery in graphite heat exchangers.

VIEWS on the NEWS

By REFLECTOR

A LETTER has reached me from Mr. J. Treeby Dickinson, chief engineer of the Technical Centre of the European Broadcasting Union, who says he was in Switzerland when the referendum on the continuance or cessation of the Rheinau hydro-electric scheme was being held. Having seen the reference to it in my notes of 24th December, he offers the following comment:—

"What is, to my mind, most significant about the referendum is that it seems to have been forced upon the Swiss Government as a result of propaganda by interested bodies which contended that the hydro-electric station would ruin the touristic value of the Rhine Falls, whereas the station is being built several miles *downstream* from the Falls. I am informed that the operation of the station will merely tend to stabilize the 'height' of the Falls, which at present varies considerably seasonally, but that it will need a very keen eye to observe any difference. Is it necessarily a characteristic of public reaction to seize upon the improbable or even the impossible, rather than upon the demonstrable facts—or does that happen because the first-mentioned viewpoints are usually better publicized?"

* * *

I cannot say that the introductory matter to a new edition of "The Installation of Electricity in Churches" which I have just seen is complimentary or commendatory. It is a poem by John Betjeman, previously broadcast in the West of England Home Service, called "Too Hard and Too Bright." It tells of the raising of funds for providing electricity in a church and among other unkind things says:—

"Despite the most impressive prices
Of our electrical devices
And though the Bishop blessed the switches
Which now deface two ancient niches,
We do not like the electric light
It's far too hard and bare and bright.
As for the heat, the bills are hot.
Unluckily the heating's not."

It is quite evident that the people of this parish did not get either the right kind of installation or the proper tariff. Following the verses there are sketches of awful examples of wiring in churches. The booklet itself aims at securing more satisfactory results.

* * *

Some publicity material which I have been shown makes reference to "An iron which takes the creases out of the housewife's brow." As the French say:—"One must suffer to be beautiful."

* * *

As I have mentioned before, electric space heating is now receiving particular attention in the United States. The latest example of this is the decision of the Pacific Gas & Electric Co. to embark upon an intensive campaign to stimulate the use of electric heating equipment. By this means the company hopes to balance its summer load which rises to a peak on account of the demand for power for air conditioning and irrigation pumping. In co-operation with local banks a scheme for financing the wiring of heating installations is being operated. It is stipulated that to qualify for this financing scheme installations must be adequate and well planned and the houses must be insulated, at least in the ceilings. Although the P.G. & E. is doing all the "promotional" work, on a large scale, the actual sales of installations and equipment are being made by electrical contractors and retailers.

* * *

A woman writer in the *Sunday Times* seems to have been unfortunate in her electrical experiences. She says:—

"I suppose we all dream of its standardization. In one room alone I use five different plugs. The voltage is 200 instead of the more usual 210, and where I used to live, also in London, it is 120. I am feeling particularly bitter at the moment as a welcome Christmas present, a new silent hair-drier, is useless because I am on d.c. current instead of a.c. Theoretically I could change to a.c., but in actual fact because another tenant in the house does not wish to, I cannot. So, instead, I have had to change my silent drier for a noisy one."

Perhaps the Electricity Board can sort this out.

* * *

Electric railways were discussed at some length in the *Electrical Review* seventy years ago (24th January, 1885). Up to that time two or three locomotives operated by primary batteries had been constructed (the first in 1842 by "Davidson, of Scotland") and several people in 1884 had the idea of using dynamo-generated energy for traction purposes. Thomas Alva Edison, approached for his views on the possibility of this form of electricity supply for the New York elevated railway gave the following characteristic reply:—

"The application of the electric motor to the car is simple, and could be effected in no time if the men could be found with nerve enough to advance the money. It will need two stations to keep the current on the tracks. I could build one at Washington Park and one near 42nd Street, and keep all the trains in motion without any trouble, including switching and stops. It can be so arranged that all power will leave the trains as they approach on the same track, and so collisions will never occur. Speaking practically, I will take the 160 engines of the Manhattan Company and put half of them in one of the stations I spoke of above and half in the other, to run the dynamos which will furnish a current of electricity. I will then buy enough old rails to reach from the battery to Harlem, and will set them up between the tracks of the elevated road. Wires from the two stations will be connected with this long railing, and the electricity will flow through it. It will be led to the electric motors, and after furnishing power to run the train, will be allowed to escape through the regular rails of the road."

LETTERS TO THE EDITOR

Responsibility cannot be accepted for the opinions expressed by correspondents. Letters should bear the writers' names and addresses, not necessarily for publication.

Railway Electrification Systems

ENGINEERS—especially electrical engineers—are most anxiously awaiting the publication of the scheme for modernizing British Railways.

As previously indicated by the British Transport Commission, it is proposed to complete the electrification of the Southern Region using the same 600 V third rail system —in spite of British Railways standardizing on the 1,500 V d.c. overhead system.

The recent inclement weather must have brought to the minds of many electrical engineers the inefficiency of this third rail system. First, frost and snow virtually insulate the conductor rails, snow also causing short circuits, and when thawing takes place flooding can cause the current from a section to be cut off.

Before such a programme is put into operation should not the Transport Commission reconsider their decision since in recent weather conditions the Eastern Region overhead electrified lines have been free from any " electrical " delays, whereas on the Southern Region whenever the temperature drops to freezing point chaos takes charge.

New Eltham, S.E.9. A. D. DIX, A.M.I.E.E.

Domestic Equipment Surveys

MAY I congratulate the " Review " on its publication of the domestic electrical equipment summaries, the latest of which appeared in your issue of 14th January. We have found these most useful and I express the hope that you will find it possible, not only to continue these surveys of fresh ranges of equipment, but also from time to time to issue revisions of previous surveys.

Bristol. G. P. FOLLETT,
Chief Purchasing Officer,
South Western Electricity Board.

[It is our intention to continue these surveys as a regular feature.—Editors, *Electrical Review.*]

Gas-Turbine Combustion Systems

THE choice between single- and multi-combustion systems for gas turbines and their influence on overall design and layout was considered in a paper presented on 14th January by Messrs. I. G. Bowen and W. Tipler (Shell Petroleum Co.) at the North-East Coast Institution of Engineers and Shipbuilders. Two diverse types were discussed: first, those intended for air transport, which carried their own weight of high-grade fuel and were required to present a symmetrical engine frontal area, and, secondly, those for stationary use, in which economical use of residual grades of fuel and reliability over long periods were the chief criteria.

Small generating plant for emergency use, such as Allen's 200 h.p. unit had incorporated single combustion chambers. In larger units, also without heat exchangers, Ruston & Hornsby TA had single chambers, but Metropolitan-Vickers for their locomotive and for the Shell Petroleum Co.'s unit employed six chambers.

For plants with heat exchangers overall compactness was lost; hence the gain in using multiple chambers with their more complicated air piping. Single chambers had been adopted for the Metropolitan-Vickers 15 MW set for the British Electricity Authority and for the B.T.H. 2·5 MW sets for the East African Power Co. Ruston & Hornsby began with a dual-chamber arrangement but changed to a single-chamber layout. Two chambers had been adopted by the B.T.H. for the tanker *Auris* and by the English Electric Co. for its 2 MW turbine. The authors made detailed technical comparisons between single-, dual- and six-chamber machines of Ruston, Metropolitan-Vickers and English Electric makes respectively for ratings of 0·9, 2·0 and 2·0 MW.

Differences in cost due to the number of chambers were small and the amount due to the chamber and fuel-handling equipment was only 3 to 5 per cent of the whole. Taking into account the desirability of reducing the number of igniters, flame monitoring devices and atomizers, as well as the providing of better accessibility, the authors favoured the minimum number of combustion chambers, especially when using residual fuel oil.

Kariba and Kafue Schemes

THE controversy over whether the Kariba Gorge hydro-electric development, on the Zambesi, or the Kafue River scheme should have precedence was carried a stage further last week when the Federal Government of Rhodesia and Nyasaland published the reports by French engineering consultants (nominated by Electricité de France) who have been examining the projects.

The subject has been under discussion since 1946 when the Inter-Territorial Hydro-Electric Commission appointed a panel under Sir William Halcrow which favoured the Kariba project. Because of the Copperbelt's electrical needs Northern Rhodesia supported the Kafue scheme, which could be brought into production sooner than Kariba, and it was decided to go ahead with it, either abandoning or postponing the Kariba plans indefinitely. Mr. Garfield Todd, Premier of Southern Rhodesia, then drew attention to the possibility of expediting construction at Kariba and the Federal Government appointed five French experts to report on the technical and economic merits of the schemes, with M. André Coyne acting as referee.

M. Coyne, in commenting on the experts' reports, recommends that the programme for the next ten years should be centred around Kariba, though preceded or perhaps accompanied by Kafue. If the Kafue scheme is started first it is considered that work must be commenced at Kariba by 1956 so that it can supplement the output at Kafue by 1963, when the estimated resources would be insufficient to meet demands. The cost of the Kariba scheme is put at £85·8 million and of the Kafue project at £55 million. It is estimated that 6,050 million kWh would be delivered annually from Kariba to receiving stations about 200 miles away at a cost of 0·254d/kWh. From Kafue it would be possible to draw 2,420 million kWh annually at a cost of 0·46d/kWh, though the output might conceivably be boosted considerably and the cost reduced. The Kariba dam would be the largest in the world, being 200 miles long and covering more than a million acres.

The Federal Government is now studying the likely rate of economic development in the territory and the availability of finance.

Encouraging Electric Heating

A resolution that the London Electricity Board should be asked to make space heating appliances available on hire-purchase terms was adopted by the Area Electricity Consultative Council at its meeting last week. Mr. G. H. Randolph Martin said that the gas industry seemed to be " getting away " with the space heating business. Mr. W. Howes condemned the use of coal fires in prefabricated bungalows in densely populated places, saying that the areas around them were smothered with pungent fumes from the low chimneys.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

THE Minister of Fuel and Power has appointed **Mr. R. Farquharson,** of Blandford, as a part-time member of the Southern Electricity Board. **Lt.-Col. D. S. Kennedy,** D.S.O., J.P., M.I.Mech.E., M.I.B.Ag.E., of Stoke, Andover, is retiring from the Board on 31st March next on completion of his term of office.

Mr. H. Schofield, C.B.E., Ph.D., B.Sc., of Loughborough, has been appointed a member of the East Midlands Electricity Consultative Council. Dr. Schofield is chairman of Crabtree Electrical Industries, Ltd., and J. A. Crabtree & Co., Ltd.

Mr. T. Pickles, B.Sc. (Eng.), A.M.I.E.E., A.M.Amer.I.E.E., has been appointed assistant chief engineer (design and planning) with the South Eastern Electricity Board. He was previously a senior assistant engineer at Seeboard's headquarters.

Mr. S. R. Butler, chief accountant to the South Wales Electricity Board, is resigning in the middle of the year to become a Unitarian Church minister. Mr. Butler is this year's president of the General Assembly of Unitarian and Free Christian Churches, and his decision is due to the present shortage of ministers. Before nationalization he was chief accountant of the South Wales Electric Power Co., and he has been chief accountant of the Board since its inception.

Sir Summers Hunter has expressed a wish to relinquish the managing directorships of the operating companies in the Richardsons Westgarth group at the end of this month in anticipation of his reaching the Group's retirement age, but he will continue to be a member of their boards. The following become the managing directors of the respective companies from 1st February:—**Mr. H. Hunter** of the North Eastern Marine Engineering Co., Ltd.; **Mr. T. P. Everett** of Richardsons Westgarth (Hartlepool), Ltd.; and **Mr. W. R. Jones** of George Clark (Sunderland), Ltd.

General Sir Daril Watson, secretary general of the British Transport Commission, will be retiring in May next. **Major-General Ll. Wansbrough-Jones,** C.B., C.B.E., will join the British Transport Commission shortly and will take over from General Watson on his retirement.

Mr. F. B. Duncan has joined the board of Ether, Ltd., and Electro Methods, Ltd., and been appointed chairman of both companies. Mr. Duncan is vice-chairman of Murphy Radio, Ltd., and is on the board of British Relay Wireless & Television, Ltd.

Sir Richard Ernest Yeabsley, C.B.E., F.C.A., F.S.A.A., has been appointed a director of the Ruberoid Co., Ltd.

Sir Arnold Gridley, who was raised to the peerage in the New Year Honours, has adopted the style and title of Baron Gridley of Stockport in the County Palatine of Chester.

Viscount Chandos, chairman of Associated Electrical Industries, Ltd., has been appointed to the board of Imperial Chemical Industries, Ltd., as a non-executive director.

Sir Hugh Warren has been appointed a director of Associated Insulation Products, Ltd.

The South of Scotland Electricity Board has announced the following appointments:—**Mr. John Henderson,** M.C., B.Sc., A.R.T.C., M.I.E.E., to be chief engineer to the Board, **Mr. Eric Maxwell,** F.I.M.T.A., F.S.A.A., to be chief financial officer, and **Mr. James Gogan,** M.I.E.E., M.S.M.A., to be chief commercial officer. The appointments take effect from 1st January.

Mr. Henderson is at present chief engineer to the South West Scotland Electricity Board. Between 1919 and 1928 he served successively in the Electricity Departments of the Glasgow and Edinburgh Corporations. In 1928 he became technical engineer in Scotland to the Central Electricity Board, and in 1944 he was appointed deputy engineer and manager of the Ayrshire Electricity Board. He held that post until 1948 when he took up his appointment with the South West Scotland Electricity Board.

Mr. J. Henderson

Mr. E. Maxwell

Mr. J. Gogan

Mr. Maxwell is chief accountant to the South East Scotland Electricity Board. From 1927 to 1948 he held appointments with Kirkcaldy Town Council, first as depute chamberlain and then from 1933 as town chamberlain and collector of rates. He relinquished that post to join the South East Scotland Electricity Board.

Mr. Gogan is chief commercial officer to the South West Scotland Electricity Board. He has thirty-nine years' service in the electricity supply industry and before his appointment with the South West Scotland Electricity Board he was development superintendent and sales manager of the former Clyde Valley Electrical Power Co.

The services of **Mr. J. F. Field,** B.Sc.(Edin.), M.I.E.E., M.I.C.E., M.I.Mech.E., controller of the South East Scotland Division of the British Electricity Authority, are to be retained by the Authority when the Division is taken over by the newly established South of Scotland Electricity Board on 1st April. Mr. Field will be employed initially in the Authority's headquarters Engineering Department, under the chief engineer, on special duties connected with the development of plant and equipment to operate on the field cycle. These arrangements have been made with the concurrence of the South of Scotland Electricity Board.

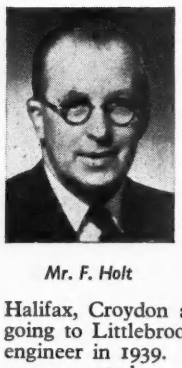
Mr. R. C. Robinson informs us that he has been appointed sales representative in the supply division of Crompton Parkinson, Ltd. He was previously home sales manager with Morphy-Richards, Ltd.

Mr. C. S. Head has joined the Jackson Electric Stove Co., Ltd., as a technical assistant in the South Western Electricity Board area.

Mr. Joseph Walton is retiring from the joint managing directorship of Thos. W. Ward, Ltd., Albion Works, Sheffield, at the end of this month, but will still be available in a consultative capacity and will retain his position as chairman and managing director of the Darlington Railway Plant & Foundry Co., Ltd. Mr. Walton joined the company as a youth, in 1904, in the Rail Department and has continued to serve in this department during his period of service. He became a local director of Thos. W. Ward, Ltd., in 1927, was made a full director in 1937, being appointed joint managing director in 1950. Mr. and Mrs. Walton intend to leave in February for a holiday in South Africa, returning to England during May.

On 1st January about 800 children of members of the **Ekco Social and Sports Club** travelled by buses to Harringay Arena, where they saw a matinee performance of Tom Arnold's Circus. The visit took the place of the usual children's Christmas party.

Mr. F. Holt, deputy superintendent at the Agecroft "B" power station since 1952, has been appointed superintendent at the Westwood (Wigan) station of the North West, Merseyside and North Wales Division, B.E.A. Mr. Holt, who received his technical education at Halifax, was successively control engineer at Halifax, Croydon and Barking before going to Littlebrook as senior control engineer in 1939. After two years he was promoted to combustion engineer and in 1946 became charge engineer at the "A" and "B" stations.

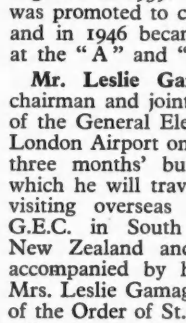


Mr. F. Holt

Mr. Leslie Gamage, M.C., vice-chairman and joint managing director of the General Electric Co., Ltd., left London Airport on 16th January for a three months' business tour during which he will travel round the world visiting overseas companies of the G.E.C. in South Africa, Australia, New Zealand and Canada. He is accompanied by his wife, the Hon. Mrs. Leslie Gamage, who, as a Dame of the Order of St. John of Jerusalem, will take the opportunity of visiting the various headquarters of the St. John Ambulance Brigade on their route.

Mr. W. E. Aitken, A.C.A., A.S.A.A., has been appointed a director of the Igranic Electric Co., Ltd. He is succeeded as secretary by **Mr. D. R. Esslemont,** C.A., A.C.W.A.

Mr. A. L. M. Ayers, A.M.I.Mech.E., who is retiring after twenty-five years' service with the *Electrical Review* as advertising representative, was the guest of honour at a luncheon held at the Savoy Hotel, London, last Friday. Mr. Claude Wallis, chairman of Electrical Review Publications, Ltd., presided, supported by Mr. H. S. Pocock, the managing director, both of whom paid tribute to Mr. Ayers. Several of his colleagues also added their appreciation of Mr. Ayers' work and qualities.



Mr. A. L. M. Ayers

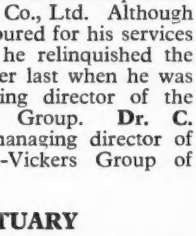
Mr. Ayers was born at Wimbledon in 1890 and was educated at Moulton Grammar School, Christ's Hospital, and the Northampton Polytechnic Institute, London. After practical training with engineering firms he became sub-editor of the *Practical Engineer*. In 1912 he joined the British Thomson-Houston Co., Ltd., Rugby, and became manager of the Advertising Department in 1919, after service as workshop officer with Mechanical Transport, R.A.S.C., in France and Greece, attaining the rank of major. While with the B.T.H. Co. he was responsible for the production of technical Press articles on a wide range of subjects. He was awarded the *Electrical Review* prize for technical advertising in 1926 and the "Trader" Cup for the best display (Edison Swan Electric Co.) at the 1928 Radio Exhibition. He came to the *Electrical Review* in 1930 and while with this journal gained the respect and affection of a great many people in the electrical industry and of his colleagues.

Dr. J. L. Miller has joined the board of the Telegraph Condenser Co., Ltd.

In referring to the knighthood conferred on **Dr. Ivor Cox** in our issue of 7th January we described him as managing director of the Metropolitan-Vickers Electrical Co., Ltd. Although Dr. Cox was honoured for his services in that capacity, he relinquished the position in October last when he was appointed managing director of the A.E.I. Overseas Group. **Dr. C. Dannatt** is the managing director of the Metropolitan-Vickers Group of companies.

OBITUARY

Mr. H. C. Booth.—Mr. Hubert Cecil Booth, F.C.G.I., M.I.C.E., died in a nursing home in Croydon on 14th January at the age of eighty-three. Mr. Booth, who was the inventor of the vacuum cleaner, was born in Glasgow and was educated at the Central Technical College, London. For many years he was in practice as a consulting engineer and was responsible for the design and construction of a large number of important bridges at home and overseas. He also played a leading part in the design and construction of the Big Wheels in Paris and Vienna, and at Earls Court and Blackpool in the early days of this century.



The late Mr. H. C. Booth

As the inventor of the vacuum cleaner in 1901, he gave rise to what was to become a world-wide industry. Apart from the domestic application of the vacuum cleaning principle, Mr. Booth applied his invention to a wide variety of industrial uses of value not only in matters of hygiene but in the elimination of the hazards of industrial disease. A recent National Coal Board report referred to the use of vacuum cleaners in mines, the first experimental plant for which was designed by Mr. Booth as far back as 1907. Mr. Booth formed the British Vacuum Cleaner & Engineering Co., Ltd., in 1924 and was joint managing director until 1946 and chairman until 1952 when he retired from the board.

Mr. J. M'F. Petters.—The death occurred on 7th January of Mr. J. M'Farquar Petters, managing director since 1919 of Taylor & Petters Ltd.

Mr. J. A. Donachie died at the Glasgow Victoria Infirmary on 31st December. Throughout his life Mr. Donachie was closely associated with electrical engineering and since 1939, in addition to his many activities, he had been Scottish agent for Bull Motors (E. R. & F. Turner, Ltd.).

Mr. W. A. H. Parker, M.I.E.E. M.Am.I.E.E., electrical consultant to the National Farmers' Union, died at his home at Putney on 15th January. Mr. Parker was born in Bristol in 1889 and after attending the Swindon Technical College was trained at Electromotors, Ltd. From 1912 to 1914 he was assistant electrical engineer with the Heywood Corporation. He then joined the Lancashire Electric Power Co., as meter and testing engineer, becoming power construction engineer in 1919. Between 1923 and 1942 he was sales engineer with the West Gloucestershire Power Co. Upon leaving the company in 1942 he acted as technical adviser to a number of industrial concerns; he was appointed consultant to the N.F.U. in 1945 with the main task of assisting members in the application of electricity to their farms and negotiating agreements with the Electricity Boards.

The late Mr. W. A. H. Parker

Mr. Parker was a member of the E.D.A. Rural Electrification Advisory Committee. He leaves a widow and a son to whom we express our sympathy.

Mr. R. H. Saunders.—The death, after an air accident, is reported from London, Ontario, of Mr. Robert Hood Saunders, C.B.E., Q.C., who had been chairman of the Hydro - Electric Power Commission of Ontario since 1948. He was fifty - one years of age.

The late Mr. R. H. Saunders

Mr. Saunders was an active advocate of the development of power from the River St. Lawrence and under his chairmanship the work of the Commission had proceeded very rapidly. He dealt with the St. Lawrence development at a luncheon arranged by the British Electrical and Allied Manufacturers' Association in 1952, when he met many leaders of the electrical industry.

Mr. W. Rintoul.—The Donovan Electrical Co., Ltd., informs us that its northern technical sales representative, Mr. W. Rintoul, died suddenly on 11th January, aged sixty-four. Mr. Rintoul, who was educated at Leeds University, was successively with Metropolitan-Vickers, and the Co-operative Wholesale Society, at Manchester, and was then for many years in business on his own account. Later he was on the sales staff of the English Electric Co., Ltd., Bradford.

WILLS

Alderman H. J. Galliers, founder of Galliers, Ltd., who died on 29th July, 1954, left £105,212 gross (£53,501 net value).

Mr. W. H. Palmer, formerly section engineer of the Transmission Department of the Central Electricity Board, Rotherham, who died 30th September last, left £5,966 gross (£3,880 net).

Mr. A. J. Sturgeon, managing director of Foster Electrical Supplies, Ltd., who died on 26th May last, left £13,707 gross (£13,453 net value).

Mr. F. W. Woodfield, A.M.I.Mech.E., M.Inst.F., manager of the Manchester office of Babcock & Wilcox, Ltd., who died on 23rd August last, left £11,279 gross (£10,491 net value).

Mr. H. J. Deacon, M.I.Mech.E., M.I.P.E., member of the General Manufacturing Department of Standard Telephones & Cables, Ltd., who died on 29th September last, left £4,589 gross (£2,950 net).

Mr. S. J. R. Allwood, A.M.I.E.E., retired principal assistant (electrical) to the mechanical and electrical engineer, British Railways, London Midland Region, Derby, who died on 1st October last, left £4,472 gross (£4,422 net).

Mr. A. R. Kenyon-Stow, formerly with Allen West & Co., who died on 4th September, left £5,331 gross (£4,593 net).

Standardizing Motor Sizes

A big step forward in the establishment of standardization of basic dimensions and outputs of electric motors has been taken by Lancashire Dynamo & Crypto, Ltd., by the introduction of a new A.A. (Anglo-American) range of protected type and totally-enclosed fan-cooled 50 c/s 3-phase motors in the 1-30 h.p. range. This is said to be a direct answer to the American action in raising their dimensions and ratings after the American N.E.M.A. range had been established.

The new L.D.C. range has been so designed that the machines are suitable for use in this country on 50 c/s 3-phase supply and yet have common outputs and fixing dimensions not only with each other, but also with the 60 c/s motors of the same type in the American new N.E.M.A. and the Canadian new C.E.M.A. ranges.

Export Licensing Control

Changes in export licensing control are made by the Export of Goods (Control) (Amendment No. 3) Order, 1955 (S.I. No. 50) (H.M. Stationery Office, 9d), which came into force on 17th January. From that date most exports to Hong Kong are freed from control. Controls over exports to China remain unchanged and no relaxations have been made in the embargo list operated by the United Kingdom and Hong Kong. A wide range of goods for destinations other than China, Macao and Tibet will be freed and certain items of strategic importance brought under control.

Among the changes which are made, licences are not now required for the export to Hong Kong of goods other than for those requiring licences to all destinations. Apart from exports to China, Macao and Tibet, licences are not now required for a wide range of products, including specified electrodes, certain diesel engines, certain capacitors, carrier and voice frequency telephone terminal equipment, certain crystal diodes, certain electronic and precision instruments, specified synthetic rubber, certain electric motors and television cameras.

Licences are now required for the export to all destinations other than the British Commonwealth, the Irish Republic and the United States of America of, *inter alia,* specified magnetic materials, specified pipe and tubing, electronic vacuum tube machinery, specified capacitor (condenser) tissue, certain electronic controlling units and fluxgate magnetometers, and certain railway signalling apparatus.

Consequent upon changes in export licensing control, the Board of Trade has issued a revised Transhipment Open General Licence (H.M. Stationery Office, 9d), which will operate as from 17th January and supersedes that of 5th May, 1954. Apart from the release from transhipment licensing control of wool, this revised licence reflects changes in the controls over strategic items subject to embargo for the Soviet bloc. Previously only some of the strategic goods embargoed to the Soviet bloc have been controlled on transhipment. Now all goods on the revised embargo list are brought under this control to prevent diversions taking place through the United Kingdom.

Packaging Exhibition

From the electrical point of view the Packaging Exhibition, which until next Friday is being held at Olympia, London, is of interest not only for the various methods demonstrated for the packaging of electrical goods, but also for the application of electricity to the operation of the many types of equipment used.

The exhibition, the fourth of its kind, is the largest of the series, with over 200 exhibitors. Among the wide range of electrically operated apparatus shown are automatic and semi-automatic machines for weighing, filling, packing, bagging, tableting, capping, wrapping, stringing, taping, wire stitching, etc. Of particular interest is a new industrial electronic metal detector shown by Cinema-Television, Ltd. This machine is a fully automatic device that will detect the presence of any metal, ferrous or non-ferrous, in any material non-metallic in itself. A maximum of six conveyor lines can be covered with one equipment, with individual control of each line. Metal detection equipment is also displayed by Goring Kerr, Ltd., and Loma Electronic Equipment, Ltd.

Among the many machines on the stand of G. D. Peters & Co., Ltd., Slough, are three which are shown for the first time. These are a hook type hopper machine for sorting objects greater in height than diameter, a carton closing unit, and a "Codamatic" machine for the individual coding of labels in any colour or size. At the stand of Samuel Jones & Co., Ltd., particular emphasis is placed on the company's labelling and sealing consultative service and here can be seen a prototype of a label moistening machine, one of the smallest of its kind, specially designed for use in offices. In addition to small labels and seals, postage stamps can also be accommodated. This company also shows a newly designed hotplate for "Heatfix" thermo-plastic labels.

Of interest to manufacturers of refrigerators and washing machines, who may be concerned in the protection of their articles in transit, is the exhibit of "Protectomuffs." These heavily padded canvas covers are complete in themselves and collapsible for easy return. Samples are available on free loan.

During the Exhibition there is a Convention in the Conference Hall at Olympia, organized by the Institute of Packaging.

Guided Electric Waves

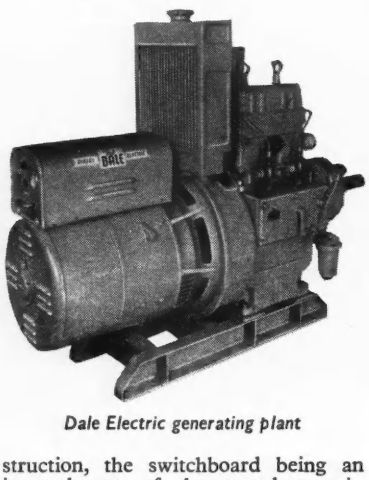
At the Patent Office on 11th January Professor H. E. M. Barlow, of University College, London, lectured on some recent researches in his laboratories and explained the nature of waveguides.

NEW ELECTRICAL EQUIPMENT

Generating Plant

A range of generating plant incorporating the new Ruston series of engines has been introduced by DALE ELECTRIC (YORKSHIRE), LTD., Filey, Yorks. The range, which extends up to 90 kVA, includes 3·5 and 7 kVA sets (Ruston Y.B. engine), 17, 27, 35 and 55 kVA sets (Ruston Y.C. engine) and 75 and 90 kVA sets (Ruston 5 and 6 Y.E. engines respectively).

All the sets are of monobloc construction, the switchboard being an integral part of the complete unit. The 3·5 and 7 kVA units are offered as automatic, semi-automatic or hand-starting sets, and the remainder (from 17 to 90 kVA) can be arranged for remote push-button control, normal electric starting or for mains failure operation. In addition, the smaller sets incorporate standard equipment providing safety shut down on low oil pressure and high water temperature.

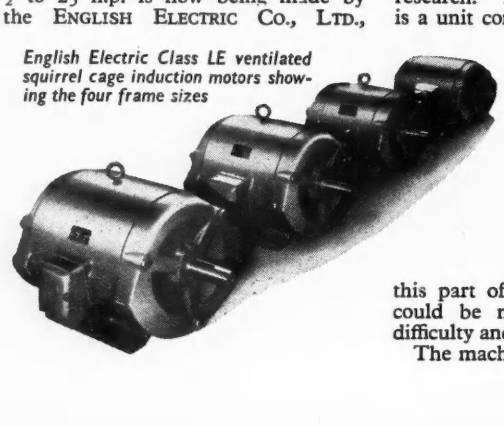


Dale Electric generating plant

Ventilated Motors

A new range of small, highly efficient, ventilated squirrel-cage induction motors having outputs from ½ to 25 h.p. is now being made by the ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, London, W.C.2. These motors, known as the Class LE, have dimensions that comply with the revised standard of the United States National Electrical Manufacturers' Association (N.E.M.A.), which calls for smaller motors in four frame diameters. These motors are available for operation at any standard supply frequency and voltage, and the bearings are of metric sizes. The endshields have wide flares to allow maximum air flow, and the vents are fully protected. A novel feature is the "trap-type" cavity in which the axial fan rotates. This provides a voluminous air-stream and ensures a cool-running machine under the most arduous conditions.

English Electric Class LE ventilated squirrel cage induction motors showing the four frame sizes



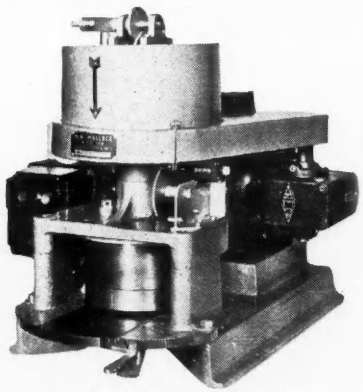
The standard position of the terminal box is on the right-hand side of the motor when looking at the non-driving end. If the terminal box is required on the left-hand side, however, this can be achieved by removing both endshields and the rotor, reversing the stator, and re-assembling. The box is normally supplied with the cable entry pointing downwards, but it can easily be turned for cable entry from right, above or left, without disturbing the motor internal leads. All machines comply with B.S. 168: 1936, have the approval of the Canadian Standards Association, and meet the requirements of the Factories Act.

Coal Grindability Measurement

A machine for measuring the grindability of coal which is to be used for producing pulverized fuel has been designed and made by H. W. WALLACE & CO., LTD., 172, St. James Road, Croydon, Surrey.

The "Hardgrove" type machine conforms with ASTM Tentative Standard D409-37T and has been carefully planned at the suggestion of the British Coal Utilization Research Association to accommodate any minor changes in the test which may be found desirable as a result of further research. The "bowl" or container is a unit complete with the pestle and balls and this can be removed from the machine for filling and emptying. The base or "grinding area" of the bowl is detachable by unscrewing a number of bolts so that should it be desirable to alter the shape or material of this part of the bowl such a change could be made with the minimum difficulty and expense.

The machine is simple to use. The loaded bowl is placed on the bed of the machine and then pushed into its working position. A lever is then pulled which lifts the bowl, places it in its station and presses it firmly against a rubber gasket which seals it effectively. Another lever is then moved which engages the drive with the pestle and also applies the required load of 64 lb. Two buttons are then pressed which cause the pestle to be rotated at 20 r.p.m. for exactly 60 revolutions. The machine then stops automatically and the procedure is reversed to remove the bowl for examination of the contents.

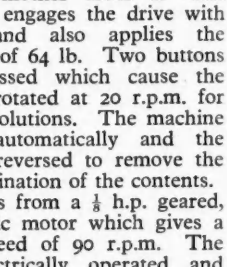


Coal grindability measuring equipment

The drive is from a ¼ h.p. geared, braked, electric motor which gives a final shaft speed of 90 r.p.m. The brake is electrically operated and brings the mechanism to rest comfortably within a quarter revolution tolerance when the 60 turns have been completed. The final drive is via an 8 mm roller chain which reduces the speed to the required 20 r.p.m.

Bulkhead Lighting Fitting

A compact fitting for recessing into ceilings and walls has recently been added to the circular bulkhead range manufactured by HOLOPHANE, LTD., Elverton Street, Westminster, London, S.W.1. The new "F.9731" fitting is an alternative to the surface mounting type and is suitable for situations such as in factories, power stations, tunnels, etc. It is claimed to withstand rough usage and variable atmospheric conditions, and a specially designed rubber seal gives effective proof against dust and moisture. The fitting is for use with 100-150 W lamps and incorporates a prismatic cover glass which controls the light and provides a wide lateral distribution. A pressurized type is also available for use where pressure-protected lighting installations are required.



Holophane "F.9781" bulkhead lighting fitting

INDUSTRIAL NEWS

Electricity Workers' Pay Claim

A claim for a substantial increase in the pay of about 120,000 manual workers in the electricity supply industry was considered at a meeting of the National Joint Council for the industry in London on Monday. Representatives of the British Electricity Authority and of five unions took part in the discussions and the meeting was adjourned until Wednesday.

Commodity Price Increases

Price index numbers of commodities published in the *Board of Trade Journal* show the substantial increases which occurred last year in the prices of materials used by the electrical manufacturing industries. The indices are based on the June, 1949, level=100 and on this basis the price of copper (ex warehouse) rose from 199·6 in December, 1953, to 240·8 last month; lead (ex ship, wharf or warehouse) from 113·5 to 130·5; aluminium (virgin ingot, delivered) from 166·7 to 173·3; zinc (ex ship, etc.) from 99·6 to 110·6; tin (ingot min. 99·75 per cent, settlement price) from 114·0 to 124·0; and rubber (No. 1 R.S.S. one-month future) from 173·1 to 250·8.

Trade Mission to Egypt

The Board of Trade announces that the Trade Mission which is to tour Egypt, the Sudan and Ethiopia under the leadership of Sir Edward Benthall, K.C.S.I., and Mr. G. C. R. Eley, C.B.E., will leave London on 29th January for Cairo. Members of the Mission include Mr. A. W. Berry, M.I.Mech.E., M.I.E.E., director, British Engineers' Association, Mr. T. A. L. Patton, B.Sc.(Eng.), M.I.C.E., Sir Alexander Gibb & Partners, and Mr. J. F. Perry, A.M.I.E.E., managing director, Metropolitan-Vickers Electrical Export Co., Ltd.

Batti-Wallahs' Society

Mr. T. C. F. Bigland, hon. secretary and treasurer of the Batti-Wallahs' Society, informs us that as a number of members have other regular engagements on the last Wednesday in each month and are consequently prevented from attending the Society's luncheons, the Committee has decided to utilize a few Thursdays available in 1955 as an experiment. The following dates have therefore been fixed for luncheons this year: 26th January (Wednesday), 24th February (Thursday), 30th March (Wednesday), 27th April (Wednesday), 26th May (Thursday), 29th June (Wednesday), 27th July (Wednesday), 29th September (Thursday), 26th October (Wednesday), 24th November (Thursday). Mr. Bigland has changed his address to 36, Eden Grove, Holloway, London, N.7 (telephone, North 4296).

The Rheostatic Company

The original business of the Rheostatic Co., Ltd., was the manufacture of resistors which was commenced in 1921; in 1928 it was expanded by the manufacture of thermostats and other temperature controls. The temperature control side of the business has grown considerably and with increasing demands the company has decided that it is desirable to concentrate its productive capacity on what is now the major part of its business, i.e. temperature controls. It has therefore decided to dispose of that part of the business concerned with the manufacture and supply of unbreakable resistors for use with heavy electrical equipment. Negotiations are almost complete for Metal Industries, Ltd., Glasgow, to take over this part as from 1st April next. The Igranic Electric Co., Ltd., Bedford, one of the Metal Industries group of companies, will then make itself responsible for the completion of all outstanding orders in relation to such resistors. The space thus freed will be employed to greater advantage by the Rheostatic Co. in meeting the heavy demand in the home and overseas markets for "Satchwell" thermostats and temperature controls.

Birmingham Transport

Writing to the *Manchester Guardian*, Mr. J. S. E. Rundle, secretary of the Associated Electric Traction Equipment Manufacturers, asks those who advocate the abolition of trams and trolley-buses to consider what has happened in Birmingham. In that city the whole of the public transport was converted to diesel-engined vehicles and when faced with traffic congestion the City Council decided to investigate the possibility of running "a light electric traction system" on the wide reserved tracks in the centre of roads on which the trams formerly ran.

Mr. Rundle says that this is an excellent suggestion: in the United States for example, such a rapid transit system is the key to the overcoming of passenger congestion in cities and towns. "It seems a pity that Birmingham City Council did not consider modernizing their electric fleet before they introduced diesel buses, particularly as their transport debt was increased by a quarter in the process of conversion."

Broader Technical Education

Commenting on the recent advocacy in a House of Lords debate of the inclusion of higher technological education courses of subjects calculated to produce men with broader interests, the Birmingham Correspondent of *The Times* refers to a four-year "sandwich" course arranged by the Birmingham College of Technology and the General Electric Co., Ltd. This course includes the following subjects:—Written and spoken communication; economic and industrial organization; development of design; legal aspects of industry; industrial relations; and human relations. The G.E.C. is arranging for students to spend a period in each of its main factories to give then a knowledge of the company's production as a whole.

Indian Import Licensing

Details are given in the *Board of Trade Journal* of 15th January of the Indian Government's import licensing policy for the first half of the current year. Among the classes of goods affected are motors and generators, switchgear, cables, instruments, lamps, fans, accessories, etc. In each case the licensing position and the period of validity of licences are shown.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £291 0s 0d
Fire Refined 99·70%	ton £289 0s 0d
Fire Refined 99·50%	ton £288 0s 0d
COPPER Tubes ..	lb 2s 10d
Sheet	ton £356 5s 0d
H.C. wire and strip ..	ton £330 5s 0d
LEAD, English ..	ton £103 15s 0d
Foreign	ton £102 0s 0d
MERCURY	flask £110 0s 0d
TIN, block (English) ..	ton £688 15s 0d
ZINC, G.O.B. Foreign	ton £84 5s 0d
Electrolytic	ton £90 11s 3d
BRASS Tubes (solid drawn)	lb 2s 3¾d
Sheet	ton £284 5s 0d
Wire	lb 2s 10½d
PHOSPHOR BRONZE Wire	lb 4s 3¾d
PLATINUM	oz £30 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 28¾d—28⅞d

English Electric Appointments

At the annual sales meeting held at Liverpool on 7th January, Mr. H. C. Timewell, manager, Domestic Appliance and Television Division of the English Electric Co., Ltd., announced details of new appointments and organization, made as a result of the recent amalgamation of the Appliance Division and Television Department.

Under these new arrangements, seven divisional area managers will be responsible to Mr. A. M. Parkinson, sales manager (home and export) for territories roughly corresponding to those of Area Boards, with Mr. V. Coffee, formerly area manager for the

division in London, as assistant sales manager (domestic appliance section), and Mr. H. Ford as assistant sales manager (T.V. section). Mr. R. J. Tilbury will continue to specialize in the division's business in overseas markets.

The six members of the staff who are promoted to area managers are: Mr. J. C. Wood, from senior representative to area manager for Scottish territories; Mr. F. J. Lochhead, formerly television sales representative, now appointed area manager for Yorkshire and the North East; Mr. W. Yates, who goes from Manchester to take over as area manager in the East Midlands, Midlands and South Wales area; Mr. J. R. Green, who transfers from the Ipswich branch to be area manager in Eastern and South East England; Mr. A. W. H. Bradstreet, appointed area manager, London and South England; and Mr. J. H. Barber, promoted from senior sales representative to area manager in the South West. There is no change in North West and North Wales, where Mr. J. E. Pearson was appointed area manager for the division a year ago with headquarters in Manchester. The new arrangements have effect from 1st January. The area managers and sales representatives are responsible for the full range of the company's domestic appliance and television receivers which are manufactured at the Liverpool Works.

Missing Document

Last week it was reported that a brief case containing a document relating to the future use of energy from nuclear fission for industrial purposes was missing from the office of Sir Henry Self, deputy chairman (administration) of the British Electricity Authority. Scotland Yard officers were said to be making inquiries into the matter but it was emphasized that there was no secret information in the document.

Works Visits

For the third year in succession the three prize-winning projectionists of the Star Cinema circuit "Best Kept Box" competition visited the Rugby and Coventry works of the British Thomson-Houston Co., Ltd. The visit is part of the prize awarded in a competition associated with an overall efficiency campaign promoted by Mr. W. Eckhart, managing director, Star Cinemas (London), Ltd., to increase the operating efficiency of their cinema projection boxes.

Eighteen Midlands Electricity Board officials, including the chief commercial officer and five other members of the Board committee, were recently guests in London of Philips Electrical, Ltd., when they visited the company's radio/TV and X-ray showrooms at Century House and later inspected industrial products at the Brixton Application Centre. Here the visitors were able to see demonstrations of equipment for high-frequency heating, arc and resistance welding and for the new stud-welding process as well as inspecting some of the range of electronic instruments, rectifiers and filtration equipment.

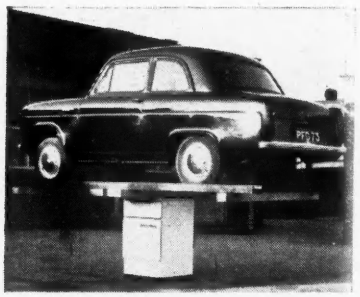
Window Display Competition

As in 1953 a window display competition was held last Christmas for all the service centres of the Yorkshire Electricity Board. For this competition the service centres are divided into two classes—Class A with a large amount of window space, and Class B with a smaller amount. In addition, consideration is given to the overall use made of all available window space and not just to one window. The selected entries were judged by Mr. A. Mercer, a director of Tattersall Advertising, Ltd., Harrogate, and the chief commercial officer. In Class A the service centre at Ferensway, Hull, was awarded the first prize and that at Sunbridge Road, Bradford, the second prize. (These two service centres occupied the same positions last year.) In Class B the first prize was won by the Normanton service centre, and the second prize by last year's winners, Holmfirth. The first prize in each class is a silver cup which is held for a year, and the second prize winners receive certificates of merit. The cup in Class A, which was retained by Hull for another year, was presented by the chairman of the Board, Mr. D. Bellamy, at a luncheon presided over by Mr. Cameron Kirby, the sub-area manager. The cup was received by Miss E. Wilson, of Hull, who had been largely responsible for the window display.

One of the windows of Hull Service Centre which won the first prize in the Christmas window display competition organized by the Yorkshire Electricity Board

A Stout Cooker

The accompanying picture shows a car supported by a Revo "Monarch" cooker. The cooker was taken from stock at random; it was in no way reinforced, and the oven and hot cupboard were opened and closed several times whilst the car was in position. After this experiment the cooker showed no signs whatever of stress, neither was the enamel in any way affected.



A Revo "Monarch" cooker supporting a motor car

Laurence, Scott Acquisition

Laurence, Scott & Electromotors, Ltd., has a controlling interest in a new company, Printing & Paper Drives, Ltd., which was registered on 1st January with a capital of £20,000.

The company will operate from 19-21, Farringdon Street, London, E.C.4, and takes over, by mutual agreement, the sale of electric rotating machinery required for the printing and allied industries hitherto conducted by Meech Electric Drives, Ltd.

Mr. J. M. Simms has been appointed managing director of the new company and Mr. J. R. Radington-Meech, of Meech Electric Drives, Ltd., is also a member of the board. In addition to developing the existing Meech business, particular attention will be given to extending the use of the company's machinery in the paper-making and allied industries.

"Russian Visit"

In Mr. F. J. Erroll's article under the above title in our issue of 7th January reference was made (p. 5) to the supply of power to Moscow from the Teplow station. Transmission is at 3·3 kV, not 33 kV as printed.

Coal Price Structure

The Federation of British Industries has published a second edition of its handbook, "Coal: The Price Structure." This was first published in June, 1952, and has now been revised

to take into account the four price revisions since that date.

The handbook, which was prepared in collaboration with the National Coal Board, describes in detail the means by which the "rank" of a coal is determined and the various adjustments which are made for ash content and other factors. It has been distributed to all F.B.I. members and is available to others at 2s, including postage.

Evershed & Vignoles' Canadian Company

The Toronto correspondent of the *Financial Times* reports that a new Canadian company, Evershed & Vignoles (Canada), is being formed in conjunction with R. H. Nichols, Ltd., and Evershed & Vignoles, Ltd., of Chiswick, which will handle exclusively the telemetering and process control side of the Evershed business. R. H. Nichols, Ltd., will continue to act as sole representative for Evershed's electrical testing instruments.

Industrial Safety

The many regulations made under the Factory Acts testify to the existence of a variety of accident risks in industry. There is a real need for guidance in the observance of these regulations and in guarding against some risks which the regulations may not cover.

This form of guidance is given in "Safety in Industry," by D. I. Macfarlane (71 pp., illustrated), just published by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, at 7s 6d (postage 3d). The variety of directions in which precautions are essential is indicated by the chapter headings:—Dust and fume control; guarding rotating machinery; press guards; dermatitis; eyes; ionising radiations; protective clothing; lighting; and flooring.

The advice given is practical and the illustrations are designed to assist in its assimilation. The matter has appeared in article form in the *Machine Shop Magazine*.

"Simple Custom"

Following the volume on "Simple Heraldry" which they published a few months ago, Tullis Russell & Co., Ltd., have produced (on their "Mellotex" matt pure white paper) a companion book, "Simple Customs," by the same authors, Iain Moncreiffe and Don Pottinger. With amusing illustrations this records and explains many British conventions, rites, pastimes, manners, etc.

British Designs for Canada

For the Canadian National Exhibition in Toronto (26th August-10th September) the Board of Trade, in association with the Council of Industrial Design, is organizing a selective display of well-designed consumer goods to be shown in the "Modern U.K." Pavilion. Selection of exhibits in all but three categories will be made from "Design Review," the Council's illustrated record of well-designed consumer goods. Manufacturers are invited to send to the Council (Tilbury House, Petty France, London, S.W.1), before 26th February, particulars of any recent work not previously submitted to "Design Review" and suitable for inclusion in the Board of Trade display, in a number of categories. The list of goods specified includes household equipment, kitchenware and lighting appliances.

B.R.A. Banquet

The British Refrigeration Association has arranged a banquet for the evening of 11th March at the Savoy Hotel, London. Mr. Selwyn Lloyd, the Minister of Supply, is to be the principal guest.

North-Eastern Trading Estates

At a Press conference at Newcastle-on-Tyne to review the progress of factories on North-Eastern trading estates, Mr. S. A. Sadler Forster (chairman, North-Eastern Trading Estates, Ltd.) said that the electrical and precision engineering industries were making the most progress. One electrical firm which had 400 employees in 1950 now had 2,000.

Mining Locomotives for Poland

An order from Poland valued at over £100,000 for fourteen battery-operated mining locomotives has just been completed by the Clayton Equipment Co., Ltd., of Hatton, Derby. The order was secured in face of German and Belgian competition. Each locomotive has a working weight of 10 tons, normal and maximum draw bar pulls of 2,500 lb and 5,000 lb respectively and an average speed, under normal haulage conditions, of 6 m.p.h. Easily adjusted for use on 550 mm, 600 mm or 620 mm gauge track, each was supplied with duplicate 180 V batteries of 90 "Exide-Ironclad" cells, type ILU17C, capacity 358 Ah at the 5-hour discharge rate.

Of all steel construction, the locomotives are built on a frame of steel plate securely braced and bolted for rigidity. The frame is cut away to accommodate the cast steel axle boxes which, machined to form a dust-proof housing for the bearings, slide on hardened steel renewable strips. The frame is supported from the axles by laminated springs. Each axle is driven by an independent motor through a worm reduction gear. The 25 h.p. 180 V series wound motors, also of Clayton manufacture, are of the totally enclosed flameproof traction type, fitted with ball bearings, one-hour rated to B.S.S. 173, wound with asbestos insulated conductors to Class B requirements and double impregnated. A flameproof manually operated, cam contactor controller, equipped with a "dead man" handle, provides four series, four parallel and six rheostatic braking notches, whilst a separate interlocked reversing drum with a removable operating key is provided together with an additional interlocked drum to cut out either of the motors. The associated equipment includes a single-pole, totally enclosed, flameproof, magnetic, blow-out type circuit breaker and a five minutes rated resistance in a flameproof housing. The battery is housed in a ventilated steel container. A 100 A double-pole, flameproof plug is provided, interlocked with the double-pole isolating switch and fuses.

A mining locomotive made by the Clayton Equipment Co. with "Exide-Ironclad" battery, for export to Poland

Refitting of Cable Ship Completed

Palmers (Hebburn) Co., Ltd., Hebburn-on-Tyne, have completed the refitting of the cable ship *Monarch*. During the refit, alterations were made to the ship to prepare her for the work, which will begin shortly, of laying the first submarine telephone cable across the Atlantic, from Oban to Nova Scotia.

Trade Announcement

The Fairless Engineering Supplies Co., Ltd., Fesco House, Bishopton Lane, Stockton-on-Tees (telephone: Stockton 66070), announces that it is reopening its electrical wholesale department, with the addition of radio, on 1st February, under the management of R. Sanderson.

F.h.p. Motor Pocket Book

Useful guidance in the choice, installation and maintenance of fractional h.p. motors is contained in an 80-page pocket book (G.13752) produced by the British Thomson-Houston Co., Ltd. In the first chapter particulars are given of the various forms of enclosure, bearings and mounting and

there are details of power supply and starting conditions. Installation is next covered, attention being paid to such points as mounting, couplings, pulleys, belt tension and switching. The third chapter includes numerous diagrams of connections for a.c. and d.c. machines; this forms the largest section. Then follow chapters on care and maintenance (including dismantling); renewals and spares; and technical data, including performance curves. The company will send a copy to any bona fide machinery manufacturer, electrical contractor or maintenance engineer who applies on business notepaper to the Manager, Technical Publications Dept., B.T.H. Co., Rugby.

Welding Summer School

The fifth Summer School of Welding organized by the British Welding Research Association will be held at Ashorne Hill, near Leamington Spa, Warwickshire, from 27th June to 2nd July. The School takes for its basic theme "Welding Developments in British Industry," and has been devised to cover various aspects in logical sequence during the course.

Application forms and programme of lectures are obtainable from the Organizing Secretary, 5th Summer School of Welding, B.W.R.A., 29, Park Crescent, London, W.1.

Machinery Trades Convention

The annual Convention of the Association of Electrical Machinery Trades will be held at Paignton, Devon, from 24th to 26th April.

I.E.E. LONDON MEETINGS

Arrangements for Second Half of the 1954-55 Session

THE Institution of Electrical Engineers has issued its programme of meetings to be held in London during the second half of the Session, and following our usual practice we list them below under their respective headings.

In addition to these meetings, other events which members may wish to note are the Faraday Lecture to be given at the Central Hall, Westminster, on Thursday next by Mr. T. B. D. Terroni on "Courier to Carrier in Communications"; the annual dinner of the Institution to be held at Grosvenor House, Park Lane, on 24th February; the Supply Section dinner-dance on 22nd March (Café Royal); and the joint dinner-dance of the Radio and Measurements Sections (Café Royal) on 30th March. A joint meeting with the Institutions of Civil and Mechanical Engineers will be held on 4th May at the Institution of Civil Engineers, when Sir Harold Hartley will deliver the first Graham Clark Lecture on "The Engineer's Contribution to the Conservation of Natural Resources." The annual general meeting of the Institution will be held on 19th May at Savoy Place, W.C.2, and the summer meeting from 6th to 11th June in the North of Scotland.

Ordinary Meetings

3rd February: "A Criterion of Distribution Cost," by D. J. Bolton (Supply Section paper). 3rd March: "The Electrical Engineering Industry in the Post-War Economy—II," by G. L. E. Metz. 31st March: "Electrical Energy from the Wind," by E. W. Golding (Supply Section paper). 21st April: Kelvin Lecture on "Transistor Physics," by Dr. W. Shockley.

Informal Meetings

7th February: Discussion on "The Problem of Radio Interference," opened by C. W. Sowton. 7th March: Discussion on "What is the Future of the Steam Locomotive?" opened by C. M. Cock. 18th April: Discussion on "Domestic Circuits and Protection Devices," opened by H. W. Swann.

Education Discussion Circle

14th February: "Discussion on "Teaching Faraday's Law of Electromagnetic Induction," opened by P. Hammond. 22nd March: Discussion on "High-Voltage Equipment in Colleges," opened by T. Siklos. 22nd April: Discussion on "Technical Training in North-West Germany," opened by Dr. K. R. Sturley. 17th May: "Questions Night."

Radio Section

24th January: "Radio Aids to Marine Navigation," by Captain F. J. Wylie, R.N. (Retd.). 9th February: "A Study of Commercial Time Lost on Transatlantic Radio Circuits due to Disturbed Ionospheric Conditions," by J. K. S. Jowett and G. O. Evans, and "Performance Characteristics of High-Frequency Radio Telegraph Circuits," by A. M. Humby, C. M. Minnis and R. J. Hitchcock. 21st February: "The Recent Search for and Salvage of the Comet Aircraft near Elba," by Commander C. G. Forsberg, R.N. and G. G. MacNeice. 2nd March: "Some Comparative Directional Measurements on Short Radio Waves over Different Transmission Paths," by E. N. Bramley; "Some Aspects of the Rapid Directional Fluctuations of Short Radio Waves Reflected at the Ionosphere," by E. N. Bramley; "On the Rapidity of Fluctuations in Continuous Wave Radio Bearings at High Frequencies," by Dr. W. C. Bain; and "Sources of Error in U-Adcock High-Frequency Direction Finding," by K. C. Bowen. 9th March: "Artificial Reverberation," by Dr. P. E. Axon, C. L. S. Gilford and D. E. L. Shorter. 21st March: Discussion on "Materials for Valves," opened by Dr. R. O. Jenkins. 20th April: "A Study of the Long-Term Emission Behaviour of an Oxide Cathode Valve. Part I: Emission Behaviour of an Oxide Cathode on a Platinum Core. Part II: Emission Behaviour of an Oxide Cathode on Passive and Active Nickel Cores," by Dr. G. H. Metson. 2nd May: "A Simple Introduction to Telegraph Codes," by H. V. Higgitt. 11th May: Group of papers on "Transistors and other Semi-Conductor Devices," including: "Junction Transistor Noise in the Frequency Range 7-50 Kc/s," by W. L. Stephenson, and "Noise in Silicon Microwave Diodes," by G. R. Nicoll.

Measurements Section

1st February: "Electrical and Magnetic Measurements in an Electrical Engineering Factory," by D. Edmundson, and "Current Summations with Current Transformers," by A. Hobson. 15th February: "The Service Engineer at an Atomic Energy Establishment," by W. E. Harris. 1st March: "Iron Losses at High Magnetic Flux Densities in Electrical Sheet Metals," by Prof. F. Brailsford and C. G. Bradshaw, and "An Improved Precision Permeameter," by Dr. C. D. Mee and Dr. R. Street. 15th March: "The Mechanism of Sub-Harmonic Generation in a Feedback System," by Dr. J. C. West and J. L. Douce, and "The Transient Behaviour of Remote-Position-Control Systems with a Hard Spring Non-Linear Characteristic," by Dr. J. C. West and P. N. Nikiforuk. 19th April: Discussion on "The Measurement of Impulse Voltages and Currents with special reference to the Testing of Surge Diverters," opened by R. Davis. 3rd May: "Medical Uses of Radioactive Isotopes," by Prof. W. V. Mayneord.

Supply Section

26th January: "Sealed Transformers," by E. B. Franklin. 23rd February: "High-Voltage Transmission Developments in Sweden," by A. Rusck. 16th March: "An Examination of High-Voltage D.C. Testing Applied to Large Stator Windings," by R. T. Rushall and J. S. Simons. 23rd March: "Proving the Performance of Circuit Breakers, with particular reference to those of Large Breaking Capacity," by J. Christie, H. Leyburn and J. F. Bird, and "A New Testing Station for High-Power Circuit Breakers," by J. Christie, H. Leyburn and R. W. Fenn. 27th April: "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care. 30th April: Visit to Lime Grove Television Studios and White City Television Centre. 18th May: "The Supply of Electricity in the London Area," by D. B. Irving. 8th-12th September: Summer visit to Holland.

Utilization Section

17th February: "An Introduction to the Study of Servo-Mechanisms," by P. J. Bhatt; "The Development of 50 c/s Traction in France," by E. J. Davies; and "Electricity Applied to Oil Production," by G. Gascoigne. 14th April: "The Installation of Metal-Sheathed Cables on Spaced Supports," by W. Holttum. 5th May: "The Electrical Activity of the Brain," by Dr. W. Grey Walter. 21st May: Summer visit to the Atomic Energy Research Establishment, Harwell.

Joint Meetings

Utilization and Supply Sections. 17th March: "The Standardization of Retail Electricity Tariffs," by A. O. Johnson and N. F. Marsh. Measurements and Radio Sections. 5th April: "High Speed Electronic-Analogue Computing Techniques," by Dr. D. M. MacKay.

Extra Meetings

10th February: "Maintenance Principles for Automatic Telephone Exchange Plant," by R. W. Palmer. 10th March: "The Electrical Equipment of the Toronto Subway Cars," by F. W. Roberts. 28th April: "The Adhesion of Electric Locomotives," by Dr. H. I. Andrews. 12th May: Discussion on "Image Intensification in Radiology," opened by Dr. W. J. Oosterkamp and Dr. G. M. Ardran.

Electricity Supply Inquiry

Power Engineers' Evidence

PREPARED by a special committee after consultation with the Association's sections, evidence has been submitted by the Electrical Power Engineers' Association to the Herbert Committee which is inquiring into the organization and operation of the electricity supply industry.

After briefly describing its constitution and objects the Association deals with its relations with the British Electricity Authority and Electricity Boards since the nationalization of the industry, mentioning the National Joint Board and the National Joint Managerial and Higher Executive Grades Committee which conduct negotiations on salaries. No opinion is given on the operation of these arrangements but readiness to give evidence on the point is expressed.

The separation of generation and distribution of electricity is considered to be sound in principle and it is thought that the policy of concentration at headquarters of the best available scientific guidance and technical opinion has resulted in the attainment of standards of power station performance higher than any known before.

Central placing of orders for the vast quantities of power station plant is essential if a conflict of priorities is to be avoided. Such a conflict might arise if the Area Boards were to combine generation with distribution, as has been suggested. Apart from this the Association is in favour of decentralization and local control where this would best serve the public interest.

Closer co-ordination may be necessary in certain directions between Area Boards and B.E.A. Divisions on works involving joint construction and the operation of " common services."

A distinction is called for between the planning and construction of power stations and the continuous operation of the stations and the grid. The existence of many everyday questions suggests decentralization, which, when expedient, should be to the smallest effective unit. The Association's bias is towards smaller generation units rather than larger ones as instanced by the amalgamation of the North Western and Merseyside Divisions.

A " two-tier," instead of the existing " three-tier," structure for Area Board organizations is favoured. Broad policy should be dealt with at headquarters and daily administration at district level. The extent of the district might vary widely according to circumstances and might even approach in some cases the size of a present sub-area. The district should be under the control of an engineer-manager and should be sufficiently large to justify its having its own specialist staff. Alternatively there might be specialist staffs serving several smaller districts.

As regards service, it is thought that emergency work outside normal hours should be carried out by manual workers, leaving staff engineers free to cope with major emergencies. More service centres are advocated. Showroom staffs should be adequately trained and knowledgeable in all branches of the Boards' work. Those responsible for service and advice to industrial and commercial consumers should have an enginering background.

The feeling of " frustration " talked of among technical staff may be exaggerated and probably arises, when it exists, from causes inseparable from any large organization where the number of positions giving independent authority on major matters must necessarily be limited. It is thought that the suggested " two-tier " structure of Electricity Board organizations might improve matters in this direction.

Excessive specialization by engineers is deprecated ; opportunities should be given to the young engineer to make himself conversant with the best management practices. The Association holds that the ideal manager is a professionally trained engineer with administrative capacity and it resents the intervention of " administration " departments in the control of engineering subordinates and workpeople. The growing habit of creating committees to decide each and every question is deprecated.

It is thought that the quality of new entrants to the technical staff, though improving, needs to be higher to ensure the continued and economical running of the industry. Higher salaries should be offered by the Electricity Boards to attract young men of quality and " technical enthusiasm."

Referring to joint consultation, the Association says that the National Joint Advisory Council has begun to take on the nature of a " true parliament " for the industry. It is advocated that as many matters as can be settled satisfactorily by the local committees should be removed from the higher councils. A major reform in advisory council working would be an " integration of levels " which would allow staff and workpeople in the industry with experience of local committee work to serve on the district and national councils. The Association stresses the need for the Electricity Boards to consult openly with the trade unions on matters of mutual concern such as efficiency and reorganization sufficiently far ahead that it cannot be said when a change of policy results that the staff and workpeople have been presented with a *fait accompli*.

" NALGO " MEMORANDUM

The National and Local Government Officers' Association is also submitting a memorandum of evidence to the Herbert Committee. This refers to changes which have already been made in the organization of the B.E.A. and Electricity Boards. It is stated that while the Association welcomes the evidence of the desire to achieve the most efficient organization and of the progress being made towards it, it would be wrong to minimize the effect of these changes upon the staff. Frequently employees are transferred to duties of a lower grade ; promotional prospects are disturbed ; and there are " upheavals in domestic life " resulting from moves from one locality to another. These aspects are held to result in reduced efficiency and it is contended that too much and too frequent reorganization can defeat its own ends.

The Association says that it is unaware of any problems of organization and efficiency which cannot be solved within the broad framework of the 1947 Electricity Act in so far as it affects England and Wales and it can see no reason to justify another major upheaval such as would result if that framework were fundamentally altered.

The need for continued reorganization within that framework is recognized but to obtain the maximum benefit the co-operation of the staff must be secured by full consultation. This, it is said, does not always take place despite the comprehensive " machinery " which has been set up for the purpose. It is recognized, however, that the operation of the machinery is improving and compares favourably with that in other industries.

GENERATION AND DEVELOPMENT

New B.E.A. Collier

The s.s. *Sir John Snell*, built by Hall, Russell & Co., Ltd., Aberdeen, for the British Electricity Authority, was launched on 11th January at Aberdeen, the naming ceremony being performed by Mrs. A. Snell. Intended for trading to the new Shoreham Harbour and the lower reaches of the River Thames, the vessel is a single-screw, self-trimming collier of about 3,700 tons dead weight on 18ft loaded draft. The collier's name commemorates the first chairman of the former Electricity Commission.

Hire-Purchase Terms Criticized

The North Eastern Electricity Board's hire-purchase terms for certain electrical equipment were discussed recently by the Newcastle-upon-Tyne and District Chamber of Trade. The Chamber was informed that the Board offered electrical goods on terms which called for no deposit until three months afterwards and that payments could be spread over five years. This, it was contended, amounted to unfair trading and was contrary to the Government's expressed wishes.

A member of the Chamber stated that sales of certain types of electrical goods in his business had fallen by 75 per cent since the Board's terms were offered.

Mr. J. F. Skipsey, manager of the Tyne Sub-Area of the Board, said that the Board was an autonomous body and there were no regulations which called for an immediate deposit on hire-purchase sales. The Board's chief business, he stated, was selling cookers to people on new housing estates.

The Chamber intends to make another approach to the Board before considering any further action.

Ulster Farm Electricity Payments

A resolution urging the Electricity Board for Northern Ireland to reduce for the next two years the premiums payable to the Board by farmers or, alternatively, to spread payment of the amounts for the two years over the next eight years, was passed by Dungannon Rural District Council on 14th January. Proposing the resolution, Mr. P. M'Grath spoke of the plight of the farmers throughout East and South Tyrone. In more prosperous times, he said, many of them had given a five-year payment guarantee to the Electricity Board for supplies. Now, owing to total loss of crops and other setbacks, many of them were unable to meet the guarantee. Copies of the resolution are to be sent to local M.P.s, the Ministry of Commerce, and all rural and county councils.

Waste Heat Utilization

An investigation is to be made by the Electricity Committee of Belfast Corporaion into the possibility of utilizing waste heat from power stations in Belfast. The question was raised some time ago by Alderman A. Scott, the Deputy Lord Mayor, and last month it was reported that the city electrical engineer (Mr. R. P. Watson) would instruct one of his officials to visit the Battersea power station when in London, where such a scheme is in operation. Alderman Scott, when interviewed, stated that he had been interested in the subject for a long time, and he felt that something should be done in Belfast.

Power Station Inquiry

The Ministry of Fuel and Power is to hold an inquiry on 8th February into the proposal of the British Electricity Authority to construct a power station between Bedlington and Blyth (Northumberland). The inquiry will be held at Bedlington by Mr. H. W. Grimmitt, chief engineering inspector with the Ministry.

Freedom of Choice

In future the first tenants of Queensbury and Shelf (Yorks) Council houses are to be allowed a choice of a gas or electric cooker.

Machkund Project

The first instalment of power from the Machkund hydro-electric project will be available by the end of this year. The share of the State of Orissa of this initial power will be about 10,000 kW, which will be almost wholly utilized for domestic purposes and for small industries in the Koraput district. About 6,000 kW is being allocated to a ferro-manganese plant proposed to be set up in Rayagada.

Record Plant Increase in Canada

All records were broken in Canada in the amount of new hydro-electric generating capacity brought into operation last year. The Water Resources Division of the Department of Natural Resources, in a review of progress during the year, states that 1,758,450 h.p. of new capacity was completed; this compares with the previous highest installation (in 1952) of 1,066,250 h.p. The greatest single addition last year was that of 735,000 h.p., in seven units, at the Sir Adam Beck No. 2 generating station of the Hydro-Electric Power Commission of Ontario, but the 450,000 h.p. marking the completion of the first stage of the Kemano-Kitimat project of the Aluminum Company of Canada was also an outstanding achievement.

The total installed capacity of water-power plants in Canada at the end of 1954 was 16,684,200 h.p., which represents the development of less than 26 per cent of the country's resources. New plants and extensions which are under construction for operation this year total roughly 1,000,000 h.p. and those for operation in later years about 2,500,000 h.p. In addition, there are several sites of high capacity which have been under investigation and on which it is probable that development will be undertaken within a few years' time.

Italy's Power Requirements

According to a recent report prepared by a special Italian Ministerial Committee, it is estimated that the country's power requirements will increase to about 50,000 million kWh per annum by 1960. Total investments needed for this purpose are estimated at 1,783,000 million lire (about £1,025 million) of which nearly half will be spent on the construction of new power plants. The financing of this important scheme will be carried out partly from domestic sources and partly by obtaining private loans abroad.

Rural Supplies in Ceylon

The Ceylon Ministry of Transport and Works is launching a rural electrification scheme to distribute power from the Laxapana hydro-electric scheme. The Minister decided on this step because people in the areas through which the transmission lines pass complained that towns far away were served with electricity while they were overlooked.

TRANSPORT

Increased Receipts from Electric Services

Since the Lancaster, Morecambe and Heysham electric train services were reinstated in September, 1953, in place of push and pull steam trains, carryings have shown an increase each month. Announcing this, British Railways (London Midland Region) say that for the year ended September, 1954, the service carried 82,341 more passengers, and earned more in receipts than during the previous year, a good result which was achieved despite the poor summer weather and in the face of competition from a frequent road service from Lancaster to Morecambe. The upward trend in traffic and receipts continues and increases over last year's improved figures are reported for recent months.

Electrification in East Africa ?

The Times reports Mr. A. F. Kirby, general manager of East African Railways, as saying last week that a decision on whether to electrify a 400-mile section of the system's main line, from Mombasa to Nakuru, is likely to be taken within a year.

Australian Electrical News

Market Conditions, Manufacture and Overseas Trade

DURING the financial year ended 30th June last, Australians spent £73·9 million on electrical appliances and radio sets compared with £61·9 million in the previous year.

The monthly production of household electrical appliances in Australia has reached a high level, with the output of domestic refrigerators and washing machines almost double what it was a year ago.

The Tariff Board, in its recent annual report, stresses that unbalanced tariff raising would do Australia more harm than good. It is confident that protected industry could meet any reasonable overseas challenge without calling for an increase in the general level of duties. Any further crisis in the balance of payments should be met by increasing exports rather than by cutting imports.

Electrical Manufacture

Detailed statistics of the value of Australian manufacture of electrical machinery and appliances for 1952-53 have now been issued. They are shown in the table below with notes of increases or decreases compared with 1951–52. The figures represent selling value at works, except for motors which are recorded by quantity. It will be seen that the range of production is wide.

In addition to the apparatus recorded in the table there are other lines of manufacture the values of which are not available for publication. These include dry-cell batteries, lamps, dish-washing machines, ironing machines and radio valves.

Since 1952-53 the production of electric motors has gone ahead rapidly, preliminary figures for 1953-54 showing an increase of over 50 per cent on the previous year.

Imports and Exports

Australian imports of dynamo-electric machinery, appliances and equipment during the second half of 1953 were valued at £A12,315,000 compared with £A12,281,000, namely a small increase. The most noteworthy advance was in filament lamps, while cable and wire showed a decline of about the same amount. The accompanying statement compares the values of the main groups in the two half-years.

During the same period Australian exports of dynamo-electric machinery and electrical appliances totalled £A1,006,000 in value compared with £A875,000 during the second half of 1952. The total for July–December, 1953, included batteries and accumulators £A204,000 (£A162,000) and communication equipment £A246,000 (£A286,000).

Official statistics just released by the Acting Commonwealth Statistician (Mr. S. R. Carver) for the year ended 30th June, 1953, show that at that date there were 349 electric light and power works in Australia, employing 10,891 persons at an annual salary and wage bill of £9·7 million. The cost of raw materials used was £3·2 million, and the cost of fuel, etc., £32·2 million, the total value of output being £60 million. The value of land and buildings was £29·5 million and of plant and machinery £94·2 million. Additions to land and buildings during the year were valued at £8·8 million and additions and replacements to plant and machinery were worth £29·2 million. The average annual salary and wage per employee was £895 and the average value of output per person engaged, £2,257.

During the year 9,832 million kWh was sold or used outside generating stations (to Government authorities, 7,425·5 million; local authorities, 880·1 million and private companies, 1,526·5 million).

Victorian Commission's Increased Sales

The Victorian State Electricity Commission reports that it sold 16 per cent more electricity in 1954 than in the previous year, sales totalling 2,815 million kWh. The actual increase was nearly twice as much as in any previous year. The Commission's net revenue surplus for the year was £359,000, after providing for full interest, depreciation and other charges and transferring £250,000 to reserves and £1,250,000 to meet interest and other expenditure directly arising from the need to defer some capital works because of insufficient loan funds. Revenue from all sources amounted to £23,681,000.

Some 33,000 new consumers were connected during the year, 8,300 of whom were previously supplied by local country undertakings which were acquired. The installed capacity of the Commission's plant at 30th June last was 811,500 kW. It will exceed one million kW by 1956 and present planning provides for over two million kW by 1960.

VALUE OF ELECTRICAL MACHINERY AND GOODS MANUFACTURED IN 1952-53

Class of Goods	1952-53 £ (000)	Inc. or dec. on 1951-52 £ (000)
Alternators	64	– 122
Generators	1,042	– 79
Transformers and convertors:		
Above 20 kVA—		
For industrial power and light	2,380	+ 670
For other industrial uses		
Below 20 kVA—		
For neon signs	81	– 16
For radio, elec. toys, etc.	125	– 104
For industrial power and light	439	– 100
For other industrial uses	206	– 53
Batteries (manufactured and/or assembled)—		
Automobile and radio	3,762	+ 411
For power plants	548	– 83
Other	395	– 24
Battery components	526	+ 23
Telegraph and telephone apparatus	5,253	– 515
Meters, Elec.: Domestic	1,155	+ 50
Other	177	– 93
Other measuring and recording apparatus	174	+ 16
Vacuum cleaners, domestic, complete	625	– 373
Lawn mowers with elec. motor	282	– 283
Floor polishing and sanding machines	360	– 619
Elec. irons	351	– 55
Fans	378	– 307
Toasters, domestic	179	*
Radiators and fires	227	– 29
Hot water jugs	168	– 87
Washing machines	4,747	– 678
Kettles	73	– 20
Urns	52	– 24
Immersion heaters	74	– 12
Mixing machines, domestic	1,846	+ 424
Water coolers	55	– 44
Elec. clocks, complete	6	– 5
Regulating, starting and controlling apparatus	6,356	+ 68
Household fittings (switches, fuses, etc.)	1,376	– 2,276
Portable tools and appliances	437	– 78
Intercommunication systems	139	+ 88
Air conditioning equipment	2,024	+ 414
Cold lighting (neon signs, etc.)	1,820	+ 123
Film projectors	70	– 13
Radiograms	3,131	+ 192
Receiving sets	1,792	*
Car radio sets	421	*
Portable, other, sets	1,450	*
Radio parts	1,779	– 534
Radio transmitting apparatus	1,840	+ 272
Other radio and amplifying apparatus	1,261	+ 63
Refrigerators, compression type	Number 15,683	Number + 2,732
Motors—		
Under 1 h.p.	566,855	+ 13,845
1 h.p. and under 2½ h.p.	15,502	– 9,207
2½ h.p. and under 5 h.p.	7,983	– 6,480
5 h.p. and under 10 h.p.	4,897	– 3,998
10 h.p. and under 50 h.p.	5,637	– 1,852
50 h.p. and over	785	+ 136

* Comparative figures not available.

ELECTRICAL IMPORTS

Class of Goods	6 months ended Dec., '52 Thou £A	6 months ended Dec., '53 Thou £A
Batteries and accumulators	196	180
Cable and wire, covered	1,600	1,183
Communication equipment, including radio	1,248	1,205
Dynamo-electric machines	3,041	3,219
Heating and cooking appliances	143	204
Lamps, filament	91	527
Protective equipment	381	254
Regulating, starting and controlling apparatus	2,443	2,072
Sparking plugs	123	230
Transformers and rectifiers	2,027	1,975
Other electrical machinery and appliances	988	1,266

Financial Section

STOCKS and SHARES

IN the Stock Exchange, the interesting feature of recent weeks has been the tendency for gilt-edged stocks and industrial ordinary shares to follow divergent courses. Symptoms of an increase in the pressure of inflation upon the economy were thought to be responsible. In such circumstances, investment nearly always swings over in favour of ordinary shares. At the same time, gilt-edged stocks have been affected by the persistence of ideas that Bank Rate may be raised as a corrective measure.

Price Changes

Continued popularity of shares connected with the production of household equipment (referred to below in connection with the rise in Parnall shares) is witnessed by improvements of 3s in Hoover, 1s 3d in British Vacuum Cleaners, 4s 3d in Vactrics. The radio group goes from strength to strength; Pye, Cossors and Ekcos all show further rises. Of the leaders in the electrical engineering group, English Electric, A.E.I. and G.E.C. all went higher. C. A. Parsons put on another 2s 6d, and now show a yield of no more than 2½ per cent on the basis of last year's dividend. Reyrolles and Plesseys, it may be noted, also stand to yield less than 3 per cent. Bakelite and others in that field were marked up in response to good results produced by British Industrial Plastics.

E.M.I. in U.S.A.

The 10s shares of Electric & Musical Industries made a lively response to news of the company's decision to acquire a majority shareholding in Capitol Records, California, stated to be one of the largest American concerns in the business. If E.M.I. succeeds also in buying the balance of the shares, the deal will involve a sum in the neighbourhood of £3 million. Means for financing the purchase are to be detailed in a later statement. Meanwhile, the impression is that an issue of ordinary shares for the purpose is unlikely. Following this news, about 3s was added to the remarkable recovery which has been going on in the price of the shares since the early part of last year. They stood then at about 11s 6d, against the present market price of 30s (the official Stock Exchange quotation remained at 26s 6d).

Decca New Shares

New 5s ordinary shares offered by way of rights to Decca Record shareholders have been changing hands at a premium of about 43s on the issue price of 15s, the old shares being called 56s 6d ex rights. The new will be available free of transfer stamp duty until the end of February. Both classes are to be entitled to participate in the one-for-two scrip issue which will come up for approval after the annual meeting in the near future. With the publication, a month ago, of the preliminary results for 1953-54, the company reported a continued rise in

Week's Price Changes

Company or Board	Nom. Value	Middle price 17th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1954 Highest	1954 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	94⅛	−½	3	3	3 3 6	97	88⅞
Brit. Elec. 1974/77	100	93½	−½	3	3	3 4 2	96½	87½
Brit. Elec 1976/79	100	98½	−½	3½	3½	3 11 0	101½	93⅞
Brit. Elec. 1974/79	100	108½	−½	4½	4½	3 18 4	111½	103⅛
Overseas Electric Supply								
Calcutta Elec.	£1	22/-		6†	6†	5 9 0†	24/6	18/7
East African Power	£1	22/6	−6d	7	7	6 4 6	23/4	19/6
Nigerian Elec.	£1	22/6		10	10	8 17 10	25/-	23/6
Palestine Elec. "A"	£1	22/-		Nil	Nil	—	21/-	16/-
Perak Hydro-Elec.	£1	20/-		6	10	10 0 0	20/-	13/9
Equipment and Manufacturing								
Aberdare Cables	5/-	13/6		25	12½*	4 12 7	14/3	8/1
Aerialite	1/-	12/3	+3d	88½	88½	7 4 3	14/6	10/9
Allen, W. H.	£1	79/6	+1/3	15	20	5 0 8	78/6	50/-
Aron Elec. Ord.	£1	56/6		20	15	5 6 4	60/-	43/-
Assoc. Elec. Ord.	£1	70/-	+3/9	20	11¼*	—	62/6	41/6
Automatic Tel. & El.	£1	71/3		15	15	—	73/-	57/3
Babcock & Wilcox	£1	72/-	−6d	18	12*	3 6 8	76/3	47/3
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/6	3/9
Bakelite	10/-	28/9	+6d	12½	12½	4 7 0	32/-	23/6
British Aluminium	£1	40/9	−6d	12	10	4 18 3	41/-	33/9
B.I. Callender's	£1	49/3	+9d	10	10	4 1 3	52/-	37/9
B.I. Callender's 6% Pref.	£1	26/3		6	6	4 11 6	26/6	24/3
British Thermostat	5/-	26/3		35	27½*	—	28/-	12/-
British Vac. Cleaner	5/-	17/-	+1/3	15	25	7 7 0	14/6	11/6
Brook Motors	10/-	42/6		20	20*	—	45/6	29/3
Brush Ord.	5/-	8/-	+3d	4	6	3 15 0	8/3	3/6
Bulgin, A. F.	1/-	4/9	+6d	30	30	6 6 4	4/3	3/2
Burco	5/-	21/3	+3d	35	25*	5 17 9	21/6	12/1
Chloride El. Storage "A"	£1	66/6	+6d	20	12½*	3 15 4	68/6	46/6
Clarke Chapman	£1	74/-	+1/6	17½	20	—	73/-	47/6
Cole, E. K.	5/-	21/-	+1/-	25	27½	3 5 6*	20/-	11/6
Cossor, A. C.	5/-	10/6	+1/-	10	10	4 15 3	11/-	7/-
Crabtree	10/-	30/-	−6d	17½	20	6 13 4	32/-	23/9
Crompton Parkinson Ord.	5/-	17/6	+9d	20	20	—	17/9	11/6
De La Rue	5/-	21/9	−9d	Nil	20	4 12 0	24/-	12/3
Decca	4/-	56/6xr		35	56½*	3 19 9	56/6	32/-
Desoutter	5/-	26/3		18	20	3 16 4	26/6	16/1
Dewhurst	2/-	7/9	+3d	19	24	6 4 0	7/6	5/1
Dictograph Tel.	2/-	7/3		20	20	5 10 4	8/-	5/2
Dubilier Condenser	1/-	5/3	+6d	25	25	—	5/3	3/3
E.M.I.	10/-	26/6		8	10	3 15 6	27/9	11/3
Electrical Components	5/-	17/3		20	20	5 16 0	16/3	10/9
Elec. Construction	£1	33/9	−1/3	15	15	4 9 0*	35/-	26/6
Enfield Cable Ord.	£1	21/3	−1/3	5	Nil	Nil	26/3	16/6
English Electric	£1	56/3	+1/3	15	10*	3 11 0	59/-	38/-
English Electric 3¾% Pref.	£1	16/9		3¾	3¾	4 9 7	16/9	15/3
Ericsson Tel.	5/-	33/9	+1/-	22†	25†	—	33/9	22/9
Ever Ready	5/-	24/-	+6d	35	40	—	26/3	17/9
Falk Stadelmann	£1	48/6		15	15	6 3 9	49/-	36/6
G.E.C. Ord.	£1	60/-	+1/3	11½	12½	4 3 4	60/-	37/6
G.E.C. 6½% Pref	£1	28/9		6½	6½	4 10 6	28/9	26/6
General Cables	5/-	16/6	−3d	30	30	9 1 9	18/-	16/3
Greenwood & Batley	£1	55/-		17½	17½	6 7 3	55/-	40/3
Hackbridge Cable	5/-	15/9	+3d	20	20	6 7 0	15/9	11/3
Hackbridge & Hewittic	5/-	24/6		20	25	5 2 0	25/-	16/10
Hall Tel. Acc.	10/-	12/-	+6d	10	10	8 6 8	13/-	10/6
Heatrae	2/-	5/6	+3d	12½	12½	4 11 0	5/6	4/-
Henley's	10/-	17/6	−9d	10½	10½	6 0 0	22/-	15/6
Holophane	5/-	17/6	+3d	20	25	7 2 10	18/-	13/1

* After capital bonus. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

turnover during the current year, which has now only a little more than two months to run. Assuming that the rate of the ordinary dividend will in any event be maintained on the capital increased by the rights issue, the prospective yield on Decca shares is now just about 4 per cent.

R. B. Pullin Results

R. B. Pullin reports another large expansion of earnings for the year ended last September, and the ordinary dividend remains at the rate of 15 per cent paid on the three previous occasions. After the announcement, the 2s shares were lower at 6s 6d; they had been up to 7s 6d about the beginning of this month. According to the preliminary statement, group profits are some 40 per cent higher at £142,000 before taxation. Provisions for tax show a relatively small increase (the company has had heavy liabilities under the excess profits levy) with the result that the net figure is more than double last year's. The amount paid in the dividend is now covered between four and five times over by the distributable surplus.

in Electrical Investments

Company or Board	Nom. Value	Middle price 17th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1954 Highest	1954 Lowest
Equipment and Manufacturing—continued.						£ s d		
Hoover	5/-	48/9	+3/-	25	45	4 12 3	51/-	26/3
I.C.I.	£1	43/9	+6d	13	15	3 8 6	43/6	26/6
Intl. Combustion	5/-	30/6	+6d	15	20	3 5 7	30/-	14/6
Johnson & Phillips	£1	45/9	+3d	15	15	6 11 3	52/6	45/6
Lancashire Dynamo	£1	55/9		12½	14	5 0 6	59/6	43/-
Laurence, Scott	5/-	14/9		15	20	3 7 9*	14/9	7/-
Lister, R. A.	£1	31/-		9	12	—	33/-	22/6
London Elec. Wire	£1	53/6	+1/-	15	10*	3 14 9	54/-	38/-
Lucas, J.	£1	43/9	−9d	10·8	7½*	3 8 6	49/-	25/3
Marryat & Scott	2/-	9/6		22½	25	5 5 3	9/6	5/11
Mather & Platt	£1	53/-	+1/6	12½	15	—	53/-	32/-
Metal Industries	£1	32/3	+3d	12	9	5 11 6	42/3	29/6
Midland Elec. Mfg.	£1	43/9		15	15	—	43/9	31/6
Morphy-Richards	4/-	30/-	+6d	40	35*	4 13 4	27/6	11/4
Murex	£1	52/-	+6d	15	15	5 15 5	57/-	49/-
Newman Ind.	2/-	2/6	+1½d	10	10	8 0 0	2/6	2/-
Oldham & Son	1/-	3/3		17½	17½	5 7 9	3/4	2/5
Parnall (Yate)	5/-	12/4½	+1/-	6	8	3 4 8	11/-	4/3
Parsons, C. A.	£1	60/-	+2/6	12½*	7½*	2 10 0	60/-	38/1
Plessey	10/-	69/-	−1/6	30	20*	2 18 6	64/-	37/10
Pye Deferred	5/-	36/6	+1/-	20	20*	2 14 9	37/-	15/7
Revo	10/-	15/-		27½	9*	6 0 0	20/3	14/-
Reyrolle	£1	95/-		12½	13¾	2 18 9	92/6	66/-
Rheostatic	4/-	15/6	+3d	19	20	5 3 3	15/9	11/-
Richardsons Westgarth	5/-	11/3		15	15*	6 13 4	12/3	6/6
Scottish Cables	4/-	19/6		20	27½	5 12 9	21/9	12/1
Siemens Ord.	£1	47/6	+2/-	10	10	4 4 2	44/-	33/9
Smith (England), S.	4/-	17/6		15	17½*	4 0 0	17/6	7/8
Southern Areas	£1	31/3		6	7½	4 16 0	32/6	17/6
Strand Elec.	5/-	9/9	+6d	17½	17½	8 19 6	10/3	8/3
Sturtevant	5/-	21/6		18·1†	18·9*†	—	22/9	14/6
Sun. Elec.	£1	33/9		15	15	8 17 9	33/9	27/6
Switchgear & Cowans	5/-	11/6		22½	10	4 7 0	13/7	9/9
Taylor Tunnicliff	5/-	11/3		25	12½*	5 11 0	12/4	10/7
T.C.C.	10/-	41/3		20	30*	—	41/3	21/3
T.C. & M.	£1	38/9		10	8½*	4 7 8	37/6	30/3
Telephone Mfg.	5/-	9/6		10	10	5 5 3	9/6	7/6
Thorn Elec.	5/-	30/-	+6d	12½	20	3 6 8	30/6	13/3
Thornycroft	£1	37/6	+1/-	25	25	—	39/6	26/6
Tube Investments	£1	82/6	+1/3	15	17½	4 5 0	81/3	60/3
Vactric	5/-	28/9	+4/3	Nil	10	1 14 9	24/6	7/6
Veritys	5/-	9/-		10	12½	6 19 0	10/6	5/-
Walsall Conduits	4/-	52/6		70	70	5 6 8	52/6	44/-
Ward & Goldstone	5/-	42/9		45	50	—	43/6	21/-
Watford	2/-	6/9		25	22½*	—	7/3	4/7
Westinghouse Brake	£1	86/3	+3/9	16	18	4 4 9	86/3	60/9
West, Allen	5/-	19/-	+1/-	15	17½	4 3 9	19/6	12/7
Wolf Electric	5/-	16/6		15	17½	5 6 0	17/6	11/-
Trusts, Transport and Communications								
Anglo-Am Tel.:								
A Ord.	100	84½	−4	6	6	7 2 10	89½	80
Ord.	100	54½		3¾	3¾	6 17 6	55½	52
Anglo-Portuguese	£1	24/9		—	8	6 9 4	25/9	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	22/-	+6d	35	50	—	24/-	13/-
Cable & Wireless:								
Ord.	£1	46/6	+1/6	8	9	3 17 6	42/9	26/2
4% Loan	100	98½		4	4½	4 1 3	98½	95½
Calcutta Trams	£1	20/6		2½†	6†	5 17 0†	24/6	17/1
Cape Elec. Trams	£1	17/-		5½	7	8 4 9	17/6	12/4
Marconi Marine	£1	34/-		10	10	5 17 8	35/-	27/6
Oriental Tel. Ord.	£1	102/-	+9d	16	16	—	101/3	82/6
Telephone Props.	£1	90/-		—	—	—	92/6	74/6
Telephone Rentals	5/-	11/-		10	10	4 11 0	11/-	9/-

Parnall (Yate)

Another acquisition announced last week concerned Parnall (Yate), who have taken over from the American Thor Corporation all the shares of Thor Appliances. The latter distributes the Thor washing machine which Parnall have been manufacturing here under licence from the American company. Parnall (Yate) 5s shares have been a lively market in recent times. They have returned into favour on the strength of reports indicating a big revival in sales of household appliances, particularly since last year's relaxation of hire-purchase restrictions. The present price of 11s 9d is more than double that ruling a year ago. Last year, the single annual dividend was declared in April. The 8 per cent then paid came from earnings equal to 22 per cent on the £750,000 ordinary capital.

Electric Batteries

References have been made recently to the demand for investments connected with the supply of electrical and other accessories to the motor car industry. The latter's great expansion schemes are presumably a factor, also, in assessing the shares of the battery manufacturers. It contributed no doubt to last year's successful sale of a "repatriated" block of some 1½ million Chloride Electrical Storage "A" shares. They stand some 3s 6d above the price of 63s at which they were then offered. Yield on the basis of last year's dividend is not much over 3¾ per cent, but the effective doubling of the interim payment on account of 1954 induces confidence in a larger total to come.

Oldham & Son

Motor car batteries were mentioned in Oldham & Son's last report as accounting for a valuable part of that company's varied activities. The 1s ordinary shares are quoted at a little over 3s to yield nearly 5½ per cent on the basis of the 17½ per cent dividend paid for 1953-54; the same rate (or its equivalent before a 100 per cent scrip issue) was paid in the two previous years. Trading profits in the past four years have been steady at around £300,000 (with a rise to £356,000 in 1951-52).

REPORTS and DIVIDENDS

Radio Rentals, Ltd.—The main figures in the accounts for the year ended 31st August last were given in our issue of 31st December. With the report and accounts now published, Mr. P. Perring-Thoms (chairman), in his statement, says that the volume of new business during the year under review remained at a high level and was in general on the same scale as that of the previous year. Demand for the television service, particularly, was very strong and a considerable amount of development work was undertaken in extending the areas in which the company's service was available. The sales and service section, which caters for those who prefer to own their sets, continued to grow and in future is expected to make a notable contribution to the earnings of the group. All the subsidiaries, except Rentevision, Ltd., which has not commenced to trade, operated at a profit. Since the end of the year under review television business has still further increased and although the number of sets being produced was materially increased, demand still outstrips supply. On the other hand the demand for radio on rental has decreased, which is due, in his opinion, to the current fashion for the small personal set which people prefer to purchase.

Parnall (Yate), Ltd., has acquired all the shares of Thor Appliances, Ltd., from the Thor Corporation, of Chicago. Thor Appliances for many years have distributed the Thor automatic washing machine, which has been manufactured in this country for that company by Parnall (Yate) under licence.

As from 1st February all home trade matters will be handled directly by Parnall (Yate), Ltd., to whom all orders and correspondence should be directed as from that date. All overseas business will continue to be handled by Thor Appliances, Ltd. The responsibility for sales promotion in the home trade will rest with Mr. F. Johnson (home sales manager of Parnall (Yate), Ltd.) and, for overseas trade, with Mr. W. Angus, who remains a director of Thor Appliances, Ltd.

Vulcan Foundry, Ltd., locomotive makers, announced last week that the English Electric Co., Ltd., was negotiating for the acquisition of the company's ordinary stock (£845,000) and the part of the ordinary stock of its subsidiary, Robert Stephenson & Hawthorns, Ltd., held by the public.

British Industrial Plastics, Ltd., reports group profits for the year ended 30th September last of £762,735, as compared with £441,987 for 1952-53. Taxation requires £305,379 and the net profit is £265,878 (against £104,120). It is proposed to pay a final ordinary dividend of 12½ per cent on £1,247,087 capital (12½ per cent on £831,392), which with the interim dividend of 7½ per cent on the smaller capital, again makes 20 per cent for the year. The balance carried forward is £298,635 (against £167,563 brought in).

Electric & Musical Industries, Ltd.—It is reported by the *Financial Times* that E.M.I. is to buy a majority holding (248,435 common shares) in Capitol Records, of Hollywood, California, at a price of $17.50 per share, and is offering to purchase the balance of shares at the same price. Treasury consent to the provision of the dollars has been obtained. If all the 476,230 common shares were bought it would involve $8·3 million (about £3 million). It is not expected that arrangements for financing the purchase will involve any issue of additional ordinary capital of E.M.I.

R. B. Pullin & Co., Ltd., report group profits for the year to 30th September last of £141,578, as compared with £98,703 for the preceding year, from which taxation of £76,036 has to be deducted. The final dividend is 10 per cent, maintaining the distribution for the year at 15 per cent.

The Coventry Gauge & Tool Co., Ltd., reports a trading profit for the year to 31st August last of £301,242, as compared with £304,389 for the preceding year, and after deducting £194,756, the net balance is £106,486 (against £86,748). The proposed final dividend is 4⅜ per cent (against 3⅛ per cent), making 6¼ per cent, free of tax (5 per cent), and the balance carried forward is £140,201 (against £146,715 brought in).

Hackbridge Cable Holdings, Ltd., is maintaining its interim ordinary dividend at 7½ per cent.

The Globe Telegraph & Trust Co., Ltd., has announced an interim dividend of 3 per cent (unchanged).

The Cables Investment Trust, Ltd., has declared an interim dividend of 3 per cent (same) on capital of £2,550,000 as increased in August last by the issue of 50,000 £10 shares at par.

New Companies

Northbourne Electrical Co., Ltd.—Registered 8th January. Capital £15,000. Dealers in radio and television sets and domestic and general electrical and other equipment and appliances, etc. Directors: F. King, C. A. Davies and D. R. Jacobs. Regd. office: 902, Wimborne Road, Bournemouth.

C. M. Hartshorne & Co., Ltd.—Registered 8th January. Capital £500. Traders in electrical and mechanical machinery, etc. Directors: Mrs. Constance M. Hartshorne and Miss Jean C. Hartshorne. Regd. office: 778, Newhey Road, Outlane, Huddersfield.

Collins Radio Co. of England, Ltd.—Registered 7th January. Capital £20,000. Designers and manufacturers of radio and television equipment, etc. Directors: A. A. Collins, R. S. Gates and L. M. Craft (directors of Collins Radio Co., Inc., and Collins Radio Co. of Canada, Ltd.). Regd. office: 115, Chancery Lane, W.C.2.

Edwards, Wyatt & Court (Installations), Ltd.—Registered 10th December. Capital £100. Electrical, electronic, refrigeration and mechanical engineers and contractors, dealers in radio and television sets, etc. Directors: A. L. Edwards, J. H. S. Wyatt, F. A. Court and P. R. Clements. Regd. office: 20a, Grant Street, London, E.13.

Winding-up Petitions

M.C.L. Electrical, Ltd., and **Southern & Metropolitan Properties, Ltd.**—Petitions for the winding up of these companies have been presented to the High Court by the Commissioners of Inland Revenue and will be heard on 24th January. Notice of intention to appear on the hearings must be sent to Mr. R. B. Waterer, Solicitor of Inland Revenue, Somerset House, Strand, London, W.C.2, by 22nd January.

Liquidations

Rushlite Battery Co., Ltd.—Winding up voluntarily. Liquidator, Mr. E. J. L. Cotton, "Beechrome," Earl Shilton, Leics., appointed 16th December.

Midland Counties Electrical Engineering Co., Ltd.—Winding up voluntarily. Liquidator, Mr. J. A. Heacock, 4, Waterloo Street, Birmingham, appointed 12th January. Particulars of claims to the liquidator by 18th February. This notice is purely formal. All claims have been or will be paid in full.

Bankruptcies

V. G. Palmer, 20, Warmdene Road, Brighton, electrical engineer.—Receiving order made 31st December on a creditor's petition.

H. C. Francis (deceased), lately carrying on business at 5a, Brighton Road, Redhill, Surrey, electrical engineer.—Supplemental dividend of 1½d in the £, payable at the Official Receiver's Office, 58-61, York Terrace, Regent's Park, London, N.W.1.

F. J. Crutchley, 14, Wellington Grove, Hulme, Manchester, carrying on business as "Frank Crutchley," at 9, York Street, Hulme, formerly residing at Urmston and carrying on business at 304, Deansgate, Manchester.—Discharged as from 14th December, 1954.

D. A. Wadsworth, 3, Kelvin Court, Chiswick, Middx., electrician.—Receiving order made 7th January, on a creditor's petition.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 23rd February from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

5804. Soc. d'Electronique et d'Automatisme.—Transmission of electric signals. 7th March, 1950. (724752.)

1951

26009. Postmaster General.—Electronic time division multiplex switches. 20th February, 1953. (724520.)

28772. Sparcatron, Ltd.—Working metals and other materials by electrical erosion. 2nd December, 1952. (724521.)

1952

384. Sparcatron, Ltd.—Electro-spark discharge apparatus. 1st April, 1953. (724524.)

7626. Exact Weight Scale Co.—Electronic regulating and/or indicating device. 25th March, 1952. (724526.)

25124. British Insulated Callender's Cables, Ltd.—Apparatus for coating wires, threads and the like. 6th October, 1953. (724760.)

25730. Johnson & Phillips, Ltd.—Fluid-filled electric cable systems. 1st October, 1953. (724533.)

1953

155. Philips Electrical Industries, Ltd.—Devices for measuring very weak currents. 2nd January, 1953. (724769.) 511. Measuring devices for low electric currents. 7th January, 1953. (724903.)

717. Standard Telephones & Cables, Ltd.—Electrical transformers. 9th January, 1953. (724537.)

863. Yardney International Corporation.—Electrodes for electric batteries or accumulators and process for making same. 12th January, 1953. (724394.)

1893. Siemens Schuckertwerke Akt.-Ges.—Arrangements for the operation of three-phase motors with an auxiliary frequency lower than the normal operating frequency. 22nd January, 1953. (724661.)

2727. Morle, C. W. (Philco Corporation).—Delay controlled pulse generator. 30th January, 1953. (724925.)

2787. Buquor, A. P., and Buquor, J. L.—Electrical plug and socket connectors. 30th January, 1953. (724667.)

3234. National Cash Register Co.—Electrical impulse counting circuits. 5th February, 1953. (724672.)

3401. Western Electric Co., Inc.—Manufacture of signal translating devices including silicon bodies. 6th February, 1953. (724930.)

3844. British Thomson-Houston Co., Ltd.—Control apparatus for electrically driven vehicles. 11th February, 1953. (724412.)

3845. General Electric Co.—Vacuum cleaners. 11th February, 1953. (724551.) 3846. Suction cleaners having insecticide vaporizers. 11th February, 1953. (724552.)

4103. Standard Telephones & Cables, Ltd.—Method of making dust cores of high permeability. 13th February, 1953. (724675.)

4271. General Electric Co., Ltd., Algar, L. R., Breadner, R. L., and Tremlett, C. A.—Metal-to-glass seals. 15th February, 1954. (724417.)

4541. Philips Electrical Industries, Ltd.—Contrast control circuit arrangements for use in television receivers. 18th February, 1953. (724941.) 4543. Frequency control systems. 18th February, 1953. (724942.)

4678. British Thomson-Houston Co., Ltd.—Continuous wave radar systems. 19th February, 1953. (724555.)

4846. Moulon, J. M.—Stabilized transistor amplifiers. 20th February, 1953. (724682.)

5007. Elektrokemisk Aktieselskab.—Suspension of electrodes in electric furnaces. 23rd February, 1953. (724423.)

5107. Westinghouse Electric International Co.—Electric lamp making machinery. 24th February, 1953. (724802.) 5108. Bucky grids for X-ray apparatus. 24th February, 1953. (724425.) 5112. Electric lamps. 24th February, 1953. (724945.)

5150. Maschinenfabrik Augsburg Nürnberg Akt.-Ges.—Turbine rotor of steel having ceramic blading. 24th February, 1953. (724805.)

5155. General Electric Co.—Magnetic gaskets. 24th February, 1953. (724946.)

5326. Compagnie Générale de Télégraphie sans Fil.—Magnets for electron tubes. 25th February, 1953. (724947.)

5438. Atomic Energy of Canada, Ltd.—Discriminator circuit. 26th February, 1953. (724949.)

5512. Erie Resistor Corporation.—Piezo electric generators. 27th February, 1953. (724950.)

5546. British Thomson-Houston Co., Ltd.—Basing of electric lamps or the like. 27th February, 1953. (724430.)

5616. Telegraph Construction & Maintenance Co., Ltd.—Terminations for electric cables. 27th February, 1953. (724688.)

5741. British Thomson-Houston Co., Ltd.—Apparatus for applying getters to leading-in wires of electric lamps and similar devices. 2nd March, 1953. (724807.)

5832. Standard Telephones & Cables, Ltd.—Metal rectifier assemblies. 3rd March, 1953. (724692.)

5876. Scholtz, S. P.—Oil-filled electric transformers. 4th June, 1953. (724809.)

6148. British Thomson-Houston Co., Ltd.—Fluid pressure and/or flow responsive electric switches. 5th March, 1953. (724697.)

6278. Philco Corporation.—Electromagnetic deflection yokes for cathode-ray tubes. 6th March, 1953. (724700.)

6286. Philips Electrical Industries, Ltd.—Contact diodes. 6th March, 1953. (724561.)

6536. Westinghouse Brake & Signal Co., Ltd.—Apparatus for the elimination of an a.c. superimposed on a d.c. circuit. 10th March, 1953. (724702.)

6839. Standard Telephones & Cables, Ltd.—Electrical capacitors. 12th March, 1953. Addition to 693062. (724564.)

7288. Allmanna Svenska Elektriska Aktiebolaget.—Air-blast high voltage circuit breakers. 17th March, 1953. (724707.)

7652. Glover & Co., Ltd., W. T.—Flexible electric cables. 18th March, 1954. (724451.)

7826. Standard Telephones & Cables, Ltd.—Microwave cavity resonators. 20th March, 1953. (724454.) 7830. Method of making magnetic cores. 20th March, 1953. (724709.)

7882. Westinghouse Electric International Co.—Dynamo-electric machines. 23rd March, 1953. (724456.)

8067. Western Electric Co., Inc.—Electric binary pulse code translating apparatus. 24th March, 1953. (724460.)

8353. Meta Soc. Per Azioni Fabrica Motori Elettrici.—Electric motors. 26th March, 1953. (724573.)

8453. Glas-Col Apparatus Co., Inc.—Electric warming device for liquids. 26th March, 1953. (724981.)

8528. Standard Telephones & Cables, Ltd.—Deflection coil arrangements for cathode-ray tubes. 27th March, 1953. (724715.)

8569/70. Ferguson Pailin, Ltd.—Cartridge type electric fuse-links. 27th March, 1953. Addition to 563600. (724574/5.)

9237. Philips Electrical Industries, Ltd.—Circuit arrangements for use in carrier wave telephone systems. 2nd April, 1953. (724582.)

9650. Leece-Neville Co. — Electrical generating system. 9th April, 1953. (724720.)

10323. Schmitz, E. (trading as Elektro-Schmitz).—Apparatus for testing the dielectric strength of the insulation of electric conductors. 15th April, 1953. (724468.)

10334. Atomic Energy of Canada, Ltd.—Trigger circuit. 15th April, 1953. (724837.)

10335. Naamlooze Vennootschap Nederlandsche Kabelfabrieken.—Method and apparatus for producing electric cables and cables produced thereby. 15th April, 1953. (724469.)

10707. Allmanna Svenska Elektriska Aktiebolaget.—Process for manufacturing divided wound cores for transformers and similar apparatus. 20th April, 1953. Addition to 696346. (724588.)

10781. Motor Products Corporation.—Refrigerator breaker strip and control assembly. 20th April, 1953. (724843.)

11136. Albiswerk Zurich Akt.-Ges.—Timing relay circuit arrangements. 22nd April, 1953. (724590.)

11185. Singer Manufacturing Co.—Electric clutch-brake driving mechanism. 23rd April, 1953. (724591.)

11347. Clevite Corporation.—Automatic frequency control of electromechanical transducers. 24th April, 1953. (724473.)

11438. Deutsche Edelstahlwerke Akt.-Ges.—Method of and apparatus for the inductive heating of metal workpieces. 24th April, 1953. (724474.)

11707. Philips Electrical Industries, Ltd.—Television systems. 28th April, 1953. (724593.)

11785. Electrical Apparatus Co., Ltd.—Devices for protecting a.c. electric motors against overload. 29th April, 1953. (724476.)

11878. Balfour, Beatty & Co., Ltd., and Dobson, J.—Spacing devices for overhead electricity transmission cables. 30th March, 1954. (724729.)

11954. Pittsburgh Plate Glass Co.—Electrically conductive colloidal graphite solution. 30th April, 1953. (724850.)

12120. Western Electric Co., Inc.—Party line telephone systems. 1st May, 1953. (724852.)

12296. Standard Telephones & Cables, Ltd.—Compressed frequency communication system. 4th May, 1953. (724478.)

12306. Philips Electrical Industries, Ltd.—Water-tight electric connection boxes. 4th May, 1953. (724596.)

12572. Westinghouse Electric International Co.—Induction heating. 6th May, 1953. (724480.)

12933. Kabushiki-Kaisha Chuoseisakusho, and Takeuchi, Y.—Starting apparatus for synchronous motors. 8th May, 1953. (724732.)

13525. Philips Electrical Industries, Ltd.—Automatic frequency control of high-frequency transmitters. 14th May, 1953. (724735.)

13866. Sperry Products, Inc.—Apparatus for generating ultrasonic waves. 18th May, 1953. (724484.)

13909. Kempff, A. J. G.—Post provided with an insulator for fixing an electric wire. 18th May, 1953. (724736.)

14183. Hazeltine Corporation.—Signal-translating apparatus for inter-carrier sound television receivers. 20th May, 1953. (724487.)

14479. Standard Telephones & Cables, Ltd.—Electrical circuits using two-electrode devices. 22nd May, 1953. Addition to 706514. (724605.)

14490. Philips Electrical Industries, Ltd.—Time dividers for use in radar apparatus. 22nd May, 1953. (724606.)

14539. Sylvania Electric Products, Inc.—Bulb loading apparatus. 22nd May, 1953. (724607.)

(*Continued on next page*)

New Patents (*continued*)

15060. Soc. des Electrodes et Refractaires Savoie.—Carbon cathodes for electrolytic cells. 29th May, 1953. (724738.)

15195. Ateliers de Constructions Electriques de Charleroi.—Apparatus for radio-frequency electric welding of plastic materials. 1st June, 1953. (724739.)

15710. Erie Resistor Corporation.—Rectifier. 8th June, 1953. (724610.)

16017. General Electric Co. — Rail vehicles. 10th June, 1953. (724611.)

16405. Philips Electrical Industries, Ltd. —Floodlight. 15th June, 1953. (724493.)

16409. Aktieselskabet Nebb.—Electric cable terminals. 15th June, 1953. (724612.)

16551. British Acoustic Films, Ltd.—Thermionic valve amplifiers. 16th June, 1953. (724613.)

16749. Metropolitan-Vickers Electrical Co., Ltd.—Radar equipment. 17th June, 1953. (724614.)

16969. Westinghouse Electric International Co.—Television receiving systems. 19th June, 1953. (724865.)

17250. Tinnerman Products, Inc.—Electrical terminal adapters. 22nd June, 1953. (724616.)

17340. Westinghouse Electric International Co.—Electric motor control systems. 23rd June, 1953. (724867.)

17409. Sylvania Electric Products, Inc.—Electric lamp base. 23rd June, 1953. (724618.)

19612. General Motors Corporation.—Dynamic brake system for diesel-electric locomotives. 15th July, 1953. (724627.)

20311 and 23010. General Motors Corporation.—Control switches for electric motors. 22nd July and 12th August, 1953. (724628 and 724749.)

21488 and 24046. General Electric Co.—Dynamo-electric machines. 4th and 31st August, 1953. (724875 and 724506.)

21752. General Electric Co.—Clothes drying machines. 6th August, 1953. (724631.)

21846. Aluminium Company of America. —Electrodes for electric furnaces. 7th August, 1953. (724876.)

22277. Telephone Manufacturing Co., Ltd.—Party line and like circuit arrangements. 12th August, 1953. (724634.)

23568. Philips Electrical Industries, Ltd. —Lighting and like circuits. 26th August, 1953. (724637.) 23825. Electric discharge tubes. 28th August, 1953. (724879.)

24522. General Electric Co.—Electric refrigerators. 4th September, 1953. (724638.)

25855. British Thomson-Houston Co., Ltd.—Manufacture of electric incandescent lamps. 18th September, 1953. (724640.)

28204. Evershed & Vignoles, Ltd.—Earth resistance measuring instruments. 13th October, 1953. (724888.)

30062. British Thomson-Houston Co., Ltd.—Electric lamp making machinery. 30th October, 1953. (724890.)

33430. Sparrow, S. F.—Device for controlling the flex of an electric iron when in use. 2nd December, 1953. (724648.)

34769. Canadian General Electric Co., Ltd.—Methods of coating wire with butyl rubber insulation. 14th December, 1953. (724649.)

STREET LIGHTING NOTES

THE major part of a large modern street lighting installation was switched on at a civic ceremony at the Town Hall, BRAINTREE, recently, some 240 "Mazda" lanterns replacing gas lighting on Class "A" roads. In the town centre where the streets are narrow and tortuous and two important traffic routes intersect, conditions at night have been greatly improved by the installation of over 40 fluorescent lanterns each housing three 5ft 80 W lamps, wall mounted where the streets are particularly narrow. The main radial roads have been lighted by some 200 "Amber" sodium refractor lanterns, each housing one 140 W lamp, mounted on Stanton pre-stressed reinforced concrete columns. Arm brackets in the complete installation will vary from 2ft to 8ft in length. The lanterns were chosen with particular consideration for simplicity of maintenance. The "Amber" lantern, constructed of aluminium alloy and moulded "Perspex," is totally weatherproof and has a smooth finish; all external metal fittings are of stainless steel. The 3-lamp fluorescent lantern has a corrosion-resistant aluminium canopy and a smooth one-piece "Perspex" cover-bowl, entirely free from drilling or riveting. The lighting scheme was prepared and is being supervised by the Urban District Council's engineering staff, the contractors being the North Midlands Engineering Co., Ltd.

WESTMINSTER City Council has decided to use fluorescent lamps for the lighting of Kensington Road and Knightsbridge, west of Albert Gate. At present these thoroughfares are gas-lit.

WANDSWORTH Borough Council has been recommended to approve the installation of sodium lighting along a further 56 classified roads and 170 residential roads at an estimated cost of £168,350.

LONGBENTON (Northumberland) U.D.C. is seeking £2,000 loan sanction for installing sodium lighting between Six Mile Bridge and Sandy Lane, Seaton Burn.

New "Mazda" sodium lighting installation in Rayne Road, Braintree

HALIFAX Corporation has provisionally approved a scheme, estimated to cost £25,500, for improved street lighting along more than 13 miles of main roads.

WISBECH Corporation has approved a scheme, estimated to cost £3,600, for street lighting in Norwich Road.

The ENNERDALE (Cumberland) Rural District Council has approved the spending of another £2,000 for electric street lighting.

BRADFORD Street Lighting Sub-Committee is proposing to include £50,000 in its estimates for 1955–56 for the improvement of street lighting in various parts of the city.

BARKING Corporation is recommended to approve a scheme for sodium lighting on the Bennington Avenue estate.

PENGE (Kent) Council has received permission to convert the lighting of side streets from gas to electricity over a period of two years. The first part of the plan will cost £12,000.

HOUGHTON-LE-SPRING U.D.C. is seeking the approval of the Ministry of Transport to carry out a street lighting conversion scheme at an estimated cost of more than £8,000.

NUNEATON Corporation proposes to install sodium lighting in Hinckley Road, Long Shoot, Tuttle Hill and Camp Hill Road at an estimated cost of £10,224. Improved street lighting in Lutterworth Road is also planned.

STOURBRIDGE Corporation is recommended to approve a scheme, estimated to cost £17,250, for the conversion from gas to electricity of the street lighting in all Class II roads, and in Swan Street and Brook Street.

MIDDLE EAST RADIO STATION

TWIN 350ft mast radio aerials directed to the Arab States have just been erected on the south coast of Cyprus. The masts are sited on a cliff overlooking the Mediterranean, enabling a completely unobstructed signal to be sent from Cyprus to the Arab mainland. It is estimated that the signal strength at the Arab mainland will be approximately equal to that provided by a transmitter of equivalent power actually sited on Arab territory. The masts have been erected by British Insulated Callender's Cables, for Sharq el Adna (the Near East Arab Broadcasting Station). On the same site new Marconi transmitters of 100 kW medium wave and 20 kW short wave outputs are being constructed for the Near East Arab Broadcasting Station, and when these come into operation early next year the station will be one of the two most powerful in the Middle East. The station is the only commercial station broadcasting to the entire Arab speaking world which includes Egypt, Iraq, Jordan, Syria, Lebanon, Saudi Arabia, Libya, Kuwait and Persian Gulf countries and the Sudan. It broadcasts solely in Arabic 14 to 16 hours a day.

NEW ZEALAND IMPORTS

ELECTRICAL imports into New Zealand, after an almost all-round increase between 1951 and 1952, fell off in 1953. The leading items, with notes of increases or decreases compared with the preceding year, are shown in the accompanying table. It will be seen that the only considerable advance was in the transformer and convertor group.

Class of Goods	1953 £ (000)	Inc. or dec. on 1952 £ (000)
Batteries and cells	121	− 75
Electrodes and carbons	62	− 14
Generators and magnetos	600	− 84
Cable and wire	2,453	− 470
Insulators and parts	144	− 59
Lamp bulbs	122	− 155
Motors under 1 h.p.	512	− 197
Ditto, 1–25 h.p.	282	− 78
Ditto, exceeding 25 h.p.	120	+ 10
Motor parts, starters, etc.	280	− 15
Electric razors	206	+ 42
Telegraph and telephone apparatus	1,546	+ 8
Transformers and convertors	984	+ 347
Vacuum cleaners and parts	126	− 88
Other elec. apparatus	2,253	− 621
Radio apparatus:		
Valves for receiving sets	98	—
Other valves	34	− 28
Other apparatus	442	− 46

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Bethnal Green.—28th January. Borough Council. Electric lamps for one year. F. H. Bristow, town clerk, Town Hall, E.2.

Bridgwater.—31st January. Borough Council. Electrical fittings, cable, etc. (Form No. 9), for one year. Borough architect, Town Hall.

Chatteris.—4th March. U.D.C. Street lighting equipment. (See this issue.)

Chester-le-Street (Durham).—4th February. R.D.C. Electrical fittings, conduit, cable, etc., for 80 new houses in Scorer's Lane, Lumley. F. Bowman, Estate Office, Great North Road, Birtley.

Coventry.—18th February. City Council. Electrical work at Coundon Court Secondary School. (See this issue.)

Durham.—County Education Committee. Electrical installations in schools. (See this issue.)

Farnworth.—7th February. Corporation. Electrical installations in 45 flats. (See this issue.)

Gillingham (Kent).—24th January. Borough Council. Switches and accessories (Form No. 13); conduit and accessories (14); wire, cables and accessories (15); and electric lamps (16) for one year. Borough engineer, Municipal Buildings.

Havant and Waterloo.—29th January. U.D.C. Electric cables and fittings (Form No. 14) for one year. Surveyor.

India.—1st March. Government of Andhra Electricity Department, Madras. 66 and 33 kV power transformers for substations for the Tungabhadra, Chittoor, Nellore and Machkund schemes. (E.S.B. 256/55. Ten/12126.)*

14th March. Damodar Valley Corporation, Calcutta. One 56,000 b.h.p. Kaplan turbine and one 47,060 kVA synchronous generator for the Panchet Hill hydro-electric power station. (E.S.B. 282/55. Ten/12127.)*

Iraq.—5th February. Directorate General of Municipalities, Bagdad. One 1,500 kVA and six 100 kVA transformers, h.v. oil circuit breaker, l.v. air-break circuit breaker, bus-section switch and ten sets of fused isolators. (E.S.B. 477/55. Ten/12138.)* 17th February. 150 kW diesel-electric generating set. (E.S.B. 31/55. Ten/12107.)* 20th February. 100 kW generating set. (E.S.B. 32/55. Ten/12108.)* 22nd February. 250 kW set. (E.S.B. 34/55. Ten/12095.)* 27th February. 50 and 100 kW diesel-electric generating sets. (E.S.B. 36/55. Ten/12097.)* 28th February. Three 100 kW and one 50 kW a.c. diesel-electric generating sets. (E.S.B. 472/55. Ten/12133.)* 1st March. One 100 kW d.c. diesel-electric generating set. (E.S.B. 473/55. Ten/12134.)* 2nd March. Three 100 kW and one 50 kW a.c. diesel-electric generating sets. (E.S.B. 474/55. Ten/12135.)* 3rd March. One 50 kW diesel-electric generating set. (E.S.B. 475/55. Ten/12136.)* 5th March. Two 50 kW diesel-electric generating sets. (E.S.B. 476/55. Ten/12143.)*

25th February. Central Foreign Purchasing Board. Thirteen portable radio sets and four radio telephone sets. (E.S.B. 513/55. Ten/12162.)*

Kuwait.—31st January. Government Department of Electricity. Twelve 100 kVA outdoor transformers. (E.S.B. 712/55. Ten/12184.)* 5th February. Fuse boxes, tandem boxes and jointing materials. (E.S.B. 711/55. Ten/12181.)*

London.—2nd February. Southwark Borough Council. Electric lamps for one year. Town clerk, Southwark Town Hall, Walworth Road, S.E.17.

11th March. India Store Department. Electrolytic plant. (See this issue.)

Neath.—2nd February. R.D.C. Street lighting equipment. (See this issue.)

Preston.—22nd February. Borough Council. Electrical installation in Ribbleton Hall New County Secondary School. Borough surveyor, Municipal Buildings.

Ryton-on-Tyne.—5th February. U.D.C. Electrical installations in 58 houses at Crawcrook. Surveyor, Council Offices.

Salford.—7th February. City Council. Supply of street lighting equipment and other materials for the year ending 31st March, 1956. (See this issue.)

Seaton Valley (Northumberland).—5th February. U.D.C. Electrical installations in 30 bungalows and houses at Cramlington. Surveyor, Council Offices, Seaton Delaval.

Stanley.—19th February. U.D.C. Street lighting equipment. (See this issue.)

Stoke-on-Trent.—7th February. Town Council. Electric lamps for six months. City surveyor, Town Hall.

Surrey.—7th February. County Council. School radio equipment for one year. (See this issue.)

Thailand.—25th February. State Railways, Bangkok. Line materials for carrier and selector ringing telephone scheme. (E.S.B. 804/55. Ten/12197.)*

United States.—15th February. U.S. Army Corps of Engineers, Seattle. Six 100,000 h.p. turbine governors and appurtenances. (E.S.B. 126/55. Ten/12146.)*

15th February. District Engineer, Corps of Engineers, U.S. Army. Switchboards, etc. for Dallas Dam power house. (E.S.B. 134/55. Ten/12115.)*

Uruguay.—15th February. Usinas Electricas y los Telefonos del Estado, Montevideo. Electrical material for the assembly of substations and switchboards. (E.S.B. 30160/54. Ten/12132.)*

15th February. Administracion Nacional de Puertos. Insulated electric conductors. (E.S.B. 494/54. Ten/12148.)*

Walsall.—31st January. Housing Department. Electrical repairs to Council houses for one year. A. E. Bywater, housing manager, Housing Department, 7, Hatherton Road.

Wembley.—12th February. Borough Council. Seven pedestrian-controlled electric trucks. Maintenance and transport engineer, Town Hall.

Weymouth and Melcombe Regis.—1st February. Borough Council. Electrically-driven pumping units (four pumping sets) for the main drainage of Preston, Contract X2. Howard Humphreys and Sons, consulting engineers, Victoria Station House, Victoria Street, London, S.W.1.

Witney.—8th February. U.D.C. Street lighting equipment. (See this issue.)

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Ashton-in-Makerfield. — U.D.C. Sixty concrete street lighting columns and lanterns, with auxiliary gear and all wiring, at Bolton Road (£4,065).—G.E.C.

Barking.—Corporation. High and medium voltage switchgear and transformer for joint pumping station (£2,915).—Metropolitan-Vickers.

Dagenham.—Borough Council. Electrical installations in dwellings on the Marks Gate estate (£2,754).—Evans & Shea.

Hull.—Transport Committee. Recommended. Electrical installation work at central omnibus station (£8,518).—Alexander Shaw & Sons.

Leeds.—City Council. Recommended. 300 Group "B" sodium street lighting lanterns (£3,846).—B.T.H.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Bilston.—Factory; Cannon Holdings, Ltd., Deepfields.

Birmingham.—Tile Cross Girls' Grammar School (£303,498), extensions to Bordesley Green Technical School (£116,241), Hilary Grove Junior and Infants' School (£185,090) and The Firs Junior and Nursery Schools (£87,882); A. J. Sheppard Fidler, city architect, Civic Centre, 1.

Blackpool.—Printing works, Clyde Street, for Eclipse Printing Co., Queen Street, Blackpool; Fairbrother, Hall & Hedges, architects, 2, Birley Street.

Presbyterian church, Layton; F. Parkinson, Ltd., Mowbray Drive.

Boreham Wood.—Methodist church and hall, Croxdale Road; Paul Mauger & Partners, architects, Parkway Chambers, Welwyn Garden City, Herts.

Bradford.—Mill, Fairweather Green; Woolcombers, Ltd., Daisy Bank, Duckworth Lane, Bradford.

Burnley.—Crematorium, Accrington Road; Taylor & Young, architects to T.C., 195, Oxford Road, Manchester, 13.

Cardiff.—Factory, Penarth Road; Goddard Industries, Ltd., Penarth Dock, Penarth.

Chesterfield.—Cinema, Newbold estate; Victoria Enterprises, Ltd., Knifesmith Gate.

Croydon.—Second stage of new technical college; Winton Thorpe & Tunnadine, heating and electrical consultants, 100, Victoria Street, London, S.W.1.

Darlington.—Technical college; borough architect, Central Buildings.

Doncaster.—First instalment of College of Further Education (£210,268); borough architect.

Dudley Colliery (Northumberland).—Pithead baths for the N.C.B. (£50,000); Middlemiss Brothers, builders, Stepney Bank, Newcastle-on-Tyne.

Fleetwood.—Marine pavilion (about £60,000); borough surveyor.

Gomersal (Yorks).—Houses (207), Barrington House site, for Spenborough U.D.C.; surveyor, Urban Council Offices, Town Hall, Cleckheaton.

Halesowen.—Swimming baths (£100,000), Stourbridge Road; town clerk, Council House.

Hull.—Block of offices for Transport Department, Ferensway (£70,000); A. Rankine, city architect, Lowgate.

Kingston-on-Thames.—New wing at the County Hall (£120,000); Surrey county architect.

Leicester.—Infants' and junior schools at Mowmacre Hill (£92,000); city architect.

Maidenhead.—Municipal buildings; C. T. Read, borough surveyor, 14, Craufurd Rise.

Maidstone.—Office block; Goodyear Tyre & Rubber Co. (Gt. Britain), Ltd., Foley estate, Sittingbourne Road.

Manchester.—Factory at Baguley for Geigy, Ltd.; Benjamin Waterhouse, architect, 134, Deansgate.

Proposed R.C. School of St. Clare at Black-

ley; Weightman & Bullen, architects, Rodney Street, Liverpool.

Flats (78), Wilmslow Road, Rusholme; A. R. Johnson, architect, 11, Peter Street.

Manchester.—Transport depot, Chorlton, for Nathan Fine, Ltd.; Matley, Brotherton & Mills, architects, 39, Oxford Road, Manchester.

Margate.—Two-storey library, Minster Road and Canterbury Road, Westgate; borough surveyor.

Newcastle-on-Tyne.—Proposed hospital on the Town Moor to replace St. Mary Magdalene Hospital; Newcastle Hospital Board, Dunira, Osborne Road, Newcastle.

Northampton.—Houses (140) for R.D.C.; R. J. Miller, surveyor, 1, Cheyne Walk.

Northumberland. — Secondary modern schools at Ponteland, Haltwhistle, Morpeth, North Sunderland, Alnwick and Tweedmouth for the C.C.; county architect, County Hall, Newcastle-on-Tyne.

Nottingham.—Erection of business premises and offices on site in Greyfriar Lane (£100,000); Nottingham Co-operative Society, Ltd., Offices, Upper Parliament St.

Oxford.—Department of Medicine for Radcliffe Infirmary; J. F. Watkins & Partners, architects, 7/8, Queen Sq., High Wycombe.

Peterborough.—Private housing estate with 657 houses and shops; Chas. W. Shelton, Ltd., Eastgate, Peterborough.

Old people's bungalows (18), 58 houses and 12 flats at rear of Eastern Avenue; city architect.

Plymouth.—Council chamber block and other buildings for central office and treasury department at the Civic Centre; J. Paton Watson, borough surveyor, Guildhall.

Richmond (Yorks).—Houses (500), for civilian workers at Catterick Camp; R.D.C. surveyor, 56, Market Place.

Scarborough.—First stage of new factory at Seamer Road, for Tessymans, Ltd.; Jaram & Son, Gladstone Street.

Smethwick.—Houses (218), Lyttleton estate; Eadie & Co. (Wolverhampton), Ltd., 29, Waterloo Road, Wolverhampton.

Stockport.—Peat Moat Secondary School, Buckingham Road; W. F. Gardner, borough surveyor, Town Hall.

Stoke-on-Trent.—New premises at Hanley for British Home Stores, Ltd.; C. Cornes & Son, Lichfield Street, Hanley.

Sunderland.—Municipal baths, Barnes Park Road; H. C. Bishop, borough architect.

Sutton Coldfield.—New premises, Reddicap Hill, for Johnsons Veterinary Products, Ltd.; Peters & Fell, Ltd., 124, Summer Road, Erdington, Birmingham.

Towcester (Northants).—Houses (52); R.D.C. architect.

Wallsend.—R.C. primary school; R. Burke, architect, Lambton Road, Newcastle-on-Tyne.

Secondary modern school; Reavell and Cahill, architects, Lloyds Bank Chambers, Alnwick.

C. of E. school (£17,000); county architect, County Hall, Newcastle-on-Tyne.

Willesden.—Factory, G.W. trading estate; Henry White & Sons, Ltd., 133, Regent Street, London, W.1.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 231, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 24th January

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Radio Group. "Some Applications of Electronics to Telecommunications," by Col. C. E. Calveley. (Joint meeting with the Birmingham Section of the Institution of Post Office Electrical Engineers.)

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Utilization Group. "Safety in the Use of Portable and Transportable Electrical Equipment in Industry," by J. W. Bunting. (To be read by P. R. Gray.)

LEEDS.—24, Aire Street, 6.15 p.m. I.E.S. Leeds Centre. "The Use of Films in the Textile Industry," by Frank Hill.

LEICESTER.—E.M.E.B., Charles Street, 6 p.m. I.E.S. Leicester Centre. "Contemporary Lighting," by K. S. Morris.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Radio Section. "Radio Aids to Marine Navigation," by Capt. F. J. Wylie, R.N. (Retd.).

STOKE-ON-TRENT. — I.E.S. Stoke-on-Trent Group. Annual dinner.

Tuesday, 25th January

BRADFORD.—Technical College Union, 1, Manville Terrace, 6.30 p.m. I.E.E. North Midland Education Discussion Circle. Discussion on, "The Scope of Protection in H.N.C. Syllabuses," opened by D. Fawcett.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Measurements Group. "Current Summations with Current Transformers," by A. Hobson.

NEWCASTLE-UPON-TYNE.—At the Institute of Mining & Mechanical Engineers, Neville Street, 6.30 p.m. Institution of Heating and Ventilating Engineers, North East Coast Branch. "Centrifugal Pumps," by N. Youatt and G. O. Stevenson.

NOTTINGHAM.—Gas Board's Demonstration Theatre, 6.30 p.m. I.E.E. East Midland Centre. "Special Effects for Television Studio Productions," by A. M. Spooner and T. Worswick.

Wednesday, 26th January

COVENTRY.—At the G.E.C. Radio Works, 7 p.m. I.E.E. South Midland Students' Section. "Potted Circuits and Printed Wiring," by R. F. Naylor.

GLASGOW. — I.E.E. South-West Scotland Students' Section. Visit to Post Office, Pitt Street, Telephone Exchange, at 7.30 p.m.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Supply Section. "Sealed Transformers," by E. B. Franklin.

Connaught Rooms, W.C.2, 12.30 for 12.55 p.m. Batti-Wallahs' Society. Luncheon, followed by an address by Mr. H. Bishop.

Waterloo Bridge House, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. Informal meeting. "London Trunk and Toll Exchanges—Their Functions and Future," by R. C. Devereux.

School of Hygiene & Tropical Medicine, Keppel Street, 6.30 p.m. British Institution of Radio Engineers, London Section. "A Survey of Tuner Designs for Multi-channel Television Reception," by D. J. Fewings and S. L. Fife.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institute, Corporation Road, 6.30 p.m. I.E.E. North Eastern Students' Section, Tees-Side meeting. "Design of Industrial Electrical Installations," by W. Knipe.

Thursday, 27th January

LONDON.—Central Hall, Westminster, 6 p.m. Institution of Electrical Engineers. Faraday Lecture: "Courier to Carrier in Communications," by T. B. D. Terroni.

Technical College, High Road, Tottenham, 7 p.m. Ministry of Works. "Latest Techniques for Electrical Installations in Small Buildings," by C. E. Bedford.

NOTTINGHAM. — Reform Club, Victoria Street, 7 p.m. Nottingham Electrical Club. "Diagnostic Uses of Electricity," by Dr. N. R. W. Simpson.

Friday, 28th January

BATH.—S.W.E.B., Old Bridge Street, 7 p.m. I.E.S. Bath & Bristol Centre. "Lighting for Photography," by R. W. Unwin.

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. "Shop Window Lighting," by R. C. Pennington; "Colour in Interior Decoration," by J. B. Horniblow; "Aspects of Industrial Lighting," by F. C. Johnson; and "Aspects of Museum Lighting," by N. W. Bertenshaw.

GILLINGHAM.—Central Hotel. Incorporated Plant Engineers, Kent Branch. Annual dinner and dance.

LIVERPOOL.—Reece's Restaurant, Parker Street. Incorporated Plant Engineers, Merseyside & North Wales Branch. Dinner and dance.

MANCHESTER.—Engineers' Club, Albert Square. Institution of Heating and Ventilating Engineers, Manchester & District Branch. Annual dinner.

NEWCASTLE-UPON-TYNE. — King's College, 6.30 p.m. I.E.E. North Eastern Students' Section, Tyneside meeting. Students' Lecture: "Communication of Information—Human, Animal and Machine," by C. Cherry.

County Hotel, Neville Street. I.E.S. Newcastle Centre. Dinner-dance.

NORTHAMPTON. — Angel Hotel, Bridge Street. Northampton & District Electrical Association. Annual dinner and dance.

WEYMOUTH.—Technical College, 6.30 p.m. I.E.E. Southern Centre. "Transistor Circuits," by G. B. B. Chaplin.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 5th February:—

No. 718,223 (design), Class 7. Electromotors, steam engines and turbines, none being for land vehicles; electric dynamos, etc. —Fichtel & Sachs Akt.-Ges., Schweinfurt-am-Main, Germany. Address for service, c/o Matthews, Haddan & Co., 31/32, Bedford Street, Strand, London, W.C.2.

THERMOIT. No. 712,278, Class 9. Electric heating elements; electrical connectors, flat irons, kettles and coffee percolators.—Metway Electrical Industries, Ltd., 52, King Street, Brighton, 1.

MAINSTAY (design). No. B726,227, Class 9. Electrical switchgear, busbars and housings, conduit materials, and parts and fittings.—W. G. Walker & Co. (Engineers), Ltd., 2, Emery Hill Street, Westminster, S.W.1.

ROVER. No. 734,347, Class 9. Radio, telephonic, television and telegraphic instruments, sound recording and sound reproducing instruments and parts.—Regentone Radio & Television, Ltd., Eastern Avenue, near Mawney's Road, Romford, Essex.

THERMINOL. No. 735,413, Class 9. Electric capacitors.—A. H. Hunt (Capacitors), Ltd., Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18.

IBIS. No. 726,300, Class 11. Domestic electric fires.—Bratt Colbran, Ltd., 10, Mortimer Street, London, W.1.